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The Forest Resources of Assam

COMPILED BY

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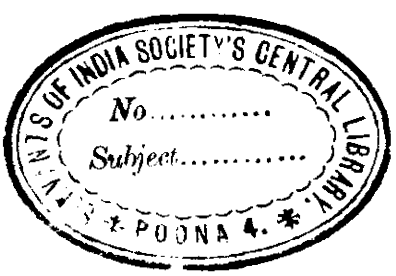

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INTRODUCTION

For a small brochure like this an introduction ordinarily is a superfluity ; but in the present case, the author feels that a brief reference to the circumstances leading to its compilation and a public acknowledgment of the assistance he has received in its preparation are essential.

The proposal for a publication of this sort was first mooted by the Inspector-General of Forests, India, as he felt that considerable misconceptions prevailed in the public mind regarding the forest wealth of the different provinces. With the introduction of provincial autonomy and the formation of popular ministries ways and means for the development of the so-called nation-building departments became the pre-occupation of legislatures and the popular press. Naturally attention was focussed on the provincial forests as suppliers of much-needed revenue and often it was found that exaggerated ideas prevailed in the public mind that forest resources which could be turned into money remained unutilised in different provinces. It was therefore felt desirable that a more or less authoritative account of the forest resources of this province and the activities of the men directly responsible for their proper and scientific utilisation should be published. The present publication is the result. If by this publication the public get a clearer idea of the provincial forest resources ; what part of them are at present being utilised, what part can be further utilised in the present circumstances provided capital is invested and initiative taken and what will perforce have to remain unutilised for a considerable period owing to a variety of reasons ; and if finance is, to a certain extent, attracted to the province for developments along the lines indicated, the object of this publication would have been more than achieved.

The author has to acknowledge the great assistance he has derived in the compilation of this small brochure from Messrs. Pearson and Brown's " Commercial Timbers of India ", Brandis' " Indian Trees " and Chopra's " Medicinal Plants of India ". The author has quoted *in extenso* from all the above publications as well as from District Gazetteers of the province.

He also wishes to acknowledge the assistance derived at the hands of Mr. H. P. Smith, Conservator of Forests, who has brought order in a jumble of facts and observations, has provided an index and in general has helped to provide an orderly presentation of the material. Mr. Smith has also amplified the author's observations as regards " Jhuming " with great effect.

The author also wishes to express his gratitude to Mr. B. P. Kar, Extra Assistant Conservator of Forests, who was of great general assistance in the compilation of this brochure.

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M. C. JACOB,

Deputy Conservator of Forests.

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The following index gives information about the uses of the different kinds of timber and bamboos mentioned in this book as also the serial numbers allotted to them in the appendix. Information about quantities and sources of supply will be available from the detailed descriptions of species forming the apppendix. Further enquiries regarding any of the species mentioned in this book may be addressed to the Divisional Forest Officer concerned, the Forest Utilisation Officer or the Conservator of Forests as follows :—

The Conservator of Forests, Assam, P. O. Shillong.

The Divisional Forest Officer,		Kachugaon	Division,	P. O. Dhubri.
Ditto	ditto	Haltugaon	,,	P. O. Dhubri.
Ditto	ditto	Garo Hills	,,	P. O. Tura.
Ditto	ditto	Kamrup	,,	P. O. Gauhati.
Ditto	ditto	Darrang	,,	P. O. Tezpur.
Ditto	ditto	Nowgong	,,	P. O. Nowgong, (Assam).
Ditto	ditto	Sibsagar	,,	P. O. Jorhat.
Ditto	ditto	Lakhimpnr	,,	P. O. Dibrugarh.
Ditto	ditto	Sadiya	,,	P. O. Sadiya.
Ditto	ditto	Cachar	,,	P. O. Silchar (also for Lushai Hills)
Ditto	ditto	Sylhet	,,	P. O. Sylhet.

The Deputy Commissioner in charge of Forests, Khasi and Jaintia Hills, Shillong, and the Forest Utilisation Officer, Assam, P. O. Gauhati.

I. (*i*) *Building*

Beams, scantlings, planking, etc., for building construction :—

Species	Vernacular name	Distribution
4. *Albizzia lebbek*, Benth	*Kothiakoroi*	All over the province not very common.
„ *lucida*, Benth ...	*Moj* ...	Throughout the province.
5. *Albizzia odoratissima*, Benth.	*Hiharu* ...	Plains of Assam from Goalpara and Sylhet to Darrang, Khasi Hills.
9. *Altingia excelsa*, Noronha	*Jutuli* ...	Upper Assam, North-East Frontier, Darrang.
12. *Artocarpus chaplasha*, Roxb.	*Sam* ...	Fairly common throughout the province.
Careya arborea, Roxb. ...	*Kumbi* ...	Nowgong, Sibsagar, Darrang, Kamrup, Goalpara, Garo Hills, Khasi Hills.
Cedrela febrifuga, C.DC.	*Jatipoma, Phatapoma.*	Occurs sporadically in evergreen forests of Lakhimpur and Sibsagar Divisions.
Cedrela microcarpa, C.DC.	*Jatipoma* ...	Rather rare, usually in hilly country ascending to 4,000 feet.
22. *Cedrela toona*, Roxb. ...	*Poma* ...	Fairly common throughout Assam.
23. *Chukrasia tabularis*, Juss.	*Bogapoma*...	Common in North-East Frontier Tract, occurs in varied proportions in all other districts.
24. *Cinnamomum cecidodaphne*, Meissn.	*Gonseroi* ...	Throughout the province.
30. *Dipterocarpus macrocarpus*, Vesque.	*Hollong* ...	Sibsagar, Lakhimpur, Sadiya, generally on hilly ground.
32. *Duabanga sonneratioides*, Ham.	*Khokon* ...	Cachar, Sylhet, Darrang, Kamrup, Goalpara, North Cachar Hills, Nowgong, Khasi and Jaintia Hills.
Echinocarpus dasycarpus, Benth.	Nil	Lakhimpur, Naga Hills and Khasi Hills.

Species	Vernacular name	Distribution
Eugenia præcox, Roxb...	*Bogi-jamuk*	Lakhimpur, Goalpara, Darrang, Nowgong, Garo Hills, Sibsagar, Cachar and Khasi and Jaintia Hills.
38. *Lagerstræmia flos-reginæ*, Retz.	*Ajhar* ...	Garo Hills, Kamrup, Nowgong, Sibsagar, Cachar, Darrang, Khasi Hills.
44. *Mesua ferrea*, Cd. Linn.	*Nahor* ...	Common and generally gregarious in almost all evergreen forests, in Upper Assam.
45. *Michelia champaca*, Linn.	*Champa* ...	Occurs sporadically in all districts generally along the foot of the hills, but not at all common.
Manglietia insignis, Blume	*Phulsopa* ...	Lakhimpur, Sibsagar, Darrang and Khasi and Jaintia Hills.
Talauma phellocarpa, King.	*Titasopa* ...	Sporadically in all Divisions except Goalpara and Kamrup.
Pachylarnax pleiocarpa ...	*Kathalpatia sopa.*	Sporadic in the Lakhimpur Division.
Nyssa sessiliflora, Hk. f.	*Gaharichapa*	Lakhimpur, Sibsagar, North Cachar Hills, Sylhet, Khasi and Jaintia Hills.
53. *Palaquium polyanthum*, Benth.	*Kurta* ...	Cachar, Sylhet, Garo Hills, Khasi and Jaintia Hills.
55. *Pinus insularis*, Royle ...	*Dieng-kseh*, Khasi.	Darrang, Khasi and Jaintia Hills.
Podocarpus neriifolia, D. Don.	*Kath-bhaluka*, Jinari.	Khasi and Jaintia Hills, Lakhimpur, Cachar, Mikir Hills.
59. *Schima wallichii*, Choisy	*Ghugra, Makria-Sal.*	Fairly common in dry and deciduous types of forests in Upper Assam.
60. *Shorea assamica*, Dyer...	*Makai* ...	Lakhimpur and Naga Hills.
61. *Shorea robusta*, Gærtn	*Sal* ...	Darrang, Khasi and Jaintia Hills, Goalpara, Kamrup, Nowgong and Garo Hills.

Species	Vernacular name	Distribution
66. *Talauma phellocarpa*, King.	*Khorika-sopa*	Lakhimpur, Sibsagar, Nowgong, Khasi Hills, Cachar and Garo Hills.
71. *Terminalia myriocarpa*, Heurck and Muell.	*Hollock* ...	North-East Frontier, Lakhimpur, Nowgong, Sibsagar, Khasi and Jaintia Hills, Goalpara, Garo Hills.
Vitex peduncularis, Wall	*Ahui* ...	Goalpara, North Cachar Hills, Khasi and Jaintia Hills, Garo Hills, Kamrup.
I. (*ii*) *Bridges*		
12. *Artocarpus chaplasha*, Roxb.	*Sam* ...	Fairly common throughout the province.
Eugenia præcox, Roxb...	*Bogi-jamuk*	Lakhimpur, Goalpara, Darrang, Nowgong, Garo Hills, Sibsagar, Cachar, Khasi and Jaintia Hills.
38. *Lagerstrmœia flos-reginæ*, Retz.	*Ajhar, Jarul*	Garo Hills, Kamrup, Nowgong, Sibsagar, Cachar, Darrang, Khasi Hills.
44. *Mesua ferrea*, Linn ...	*Nahor* ...	Common and generally gregarious in almost all evergreen forests in Upper Assam.
61. *Shorea robusta*, Gærtn	*Sal* ...	Darrang, Khasi and Jaintia Hills, Goalpara, Kamrup, Nowgong and Garo Hills.
71. *Terminalia myriocarpa*, Heurck and Muell.	*Hollock* ...	North-East Frontier, Lakhimpur, Nowgong, Sibsagar, Khasi and Jaintia Hills, Cachar, Lushai Hills, Goalpara, Garo Hills.
II. (*i*) *Bridge piles*		
38. *Lagerstrœmia flos-reginæ*, Retz.	*Ajhar, Jarul*	Garo Hills, Kamrup, Nowgong, Sibsagar, Cachar, Darrang, Khasi Hills.

Species	Vernacular name	Distribution
44. *Mesua ferrea*, Linn. ...	*Nahor* ...	Common and generally gregarious in almost all evergreen forests in Upper Assam ; large sized trees now common only in Sadiya and Balipara Frontier Tract.
61. *Shorea robusta*, Gærtn.	*Sal* ...	Darrang, Khasi and Jaintia Hills, Goalpara, Kamrup, Nowgong.
	II. (*ii*) *Posts*	
1. *Acacia catechu*, Willd. ...	*Khoir* ...	Sadiya, Darrang, Kamrup and Goalpara.
Aegle marmelos, Corr. ...	*Bel* ...	Throughout the province, cultivated.
18. *Bridelia retusa*, Spreng.	*Kohir* ...	Goalpara, Garo Hills, North Cachar Hills, Nowgong, Kamrup, Darrang, Sibsagar Lakhimpur and Khasi and Jaintia Hills.
Careya arborea, Roxb. ...	*Kumbi* ...	Nowgong, Sibsagar, Darrang, Kamrup, Goalpara, Garo Hills, Khasi Hills.
20. *Cassia fistula*, Linn. ...	*Sonaru* ...	Almost all over the province ascending about 2,000′ in Khasi and Jaintia Hills.
Cordia fragrantissima, Kurz.	*Bahari* ...	Lushai Hills, Cachar, North Cachar Hills, Sylhet, Garo Hills, Sibsagar, Darrang, Nowgong, Khasi and Jaintia Hills.
Eugenia præcox, Roxb...	*Bogi-jamuk*	Lakhimpur, Goalpara, Darrang, Nowgong, Garo Hills, Sibsagar, Cachar, Khasi and Jaintia Hills.
38. *Lagerstræmia flos-reginae*, Retz.	*Ajhar, Jarul*	Garo Hills, Kamrup, Nowgong, Sibsagar, Cachar, Darrang, Khasi Hills.
44. *Mesua ferrea*, Linn. ...	*Nahor* ...	Common and generally gregarious in almost all evergreen forests in Upper Assam.

Species	V. Name	Distribution
Polyalthia jenkinsii, Benth	*Kolioroi* ...	Found in all the districts specially of Upper Assam.
61. *Shorea robusta*, Gaertn	*Sal* ...	Darrang, Khasi and Jaintia Hills, Goalpara, Kamrup, Nowgong and Garo Hills.
Vitex peduncularis, Wall	*Ahui* ...	Goalpara, North Cachar Hills, Kamrup, Khasi and Jaintia Hills.
	II. (*iii*) *Railway Sleepers*	
44. *Mesua ferrea*, Linn ...	*Nahor* ...	Common and generally gregarious in almost all evergreen forests in Upper Assam.
61. *Shorea robusta* Gaertn...	*Sal* ...	Darrang, Khasi and Jaintia Hills, Goalpara, Kamrup, Nowgong, Garo Hills.
9. *Altinga excelsa*, Noronha	*Jutuli* ...	Upper Assam, North-East Frontier, Darrang.
7. *Alseodaphne owdenii*, PARKER.	*Jati-sundi Til-sundi*	Cachar.
16. *Bischoa javanica*, BL. ...	*Uriam*	Common throughout the province up to 4,000'. Used also untreated but not very durable.
21. *Castanopsis hystrix*, *A.DC.*	*Daba-hingori*	Sibsagar, Goalpara, Darrang Sylhet, Nowgong, North-East Frontier, Khasi and Jaintia Hills, North Cachar Hills.
26. *Cynometra polyandra*, Roxb.	*Ping* ...	Sylhet, Cachar, Garo Hills, Lushai Hills, Khasi Hills and Lakhimpur.
30. *Dipterocarpus macrocarpus* Vesque.	*Hollong* ...	Sibsagar, Lakhimpur, Naga Hills generally on hilly ground.
38. *Lagerstroemia flos-reginae*, Retz.	*Ajhar, Jarul*	Garo Hills, Kamrup, Nowgong, Sibsagar, Cachar, Darrang, Khasi Hills. Also used untreated but not very durable.
Magnolia griffithii, Hk. F. &T.	*Pan.-sopa, Gohori-sopa.*	Lakhimpur, Sibsagar, Darrang.
60. *Shorea assamica*, Dyer...	*Makai* ...	Lakhimpur and Naga Hills.
71. *Terminalia myriocarpa*, Heurck & Muell.	*Hollock* ...	North-East Frontier, Lakhimpur, Nowgong Sibsagar, Khasi and Jaintia Hills, Cachar, Lushai Hills, Goalpara, Garo Hills.

Only the first two of the above list are durable without antiseptic treatment.

Most of the above timbers after treatment (creosote) are very suitable for bridge and building structures and also for piles and are very durable.

III. *Carpentry, Cabinet and Joinery*

Species	V. Name	Distribution
2. *Acrocarpus fraxinifolius*, Wight.	*Mech-kuri-bol*	Goalpara, Garo Hills, Khasi Hills, Nowgong, Sylhet.
3. *Adina cordifolia*, Hk. f.	*Tarakchopa*	Common throughout Assam with the exception of Upper Assam.
10. *Amoora wallichii*, King	*Amari* ...	Fairly common in Upper Assam and also in the Surma Valley.
22. *Cedrela toona*, Roxb.	*Poma* ...	Fairly common throughout the province.
24. *Cinnamomum cecidodaphne*, Meissn.	*Gonseroi* ...	Throughout the province.
25. *Cinnamomum glanduliferum*, Meissn.	*Gonseroi Gonhorai.*	North-East Frontier Tract, Lakhimpur, Sibsagar, Kamrup, Khasi and Jaintia Hills.
23. *Ckukrasia tabularis*, Juss	*Bogapoma* ...	Common in North-East Frontier and in Balipara Frontier Tract ; occurs in varied proportions in all other districts.
Dillenia indica ...	*Otenga*	
27. *Dalbergia sissoo*, Roxb	*Hihu* ...	Darrang, Kamrup, Goalpara, North-East Frontier.
Fraxinus floribunda, Wall	*Di en g-l a-mahek, Khasi.*	Khasi Hills up to 5000'.
34. *Gmelina arborea*, Linn	*Gomari* ...	Common throughout the province.
39. *Lagerstroemia parviflora*, Roxb.	*Sida* ...	Golapara, Nowgong, Khasi and Jaintia Hills, Kamrup, Darrang, North Cachar Hills.
45. *Michelia champaca*, Linn.	*Tita-sopa* ...	Occurs sporadically in all districts generally along the foot of the hills but not at all common.
Manglietia insignis, Blume	*Phulsopa* ...	Lakhimpur, Sibsagar, Darrang and Khasi and Jaintia Hills.

Species	V. Name	Distribution
Pachylarnax pleiocarpa ...	*Cathalpatia sopa.*	Sporadic in the Lakhimpur Division.
50. *Morus laevigata*, Wall...	*Bola* ...	Nowgong, Sibsagar, Lakhimpur, Darrang, Cachar, Goalpara, Garo Hills, North-East Frontier, North Cachar Hills, Khasi and Jaintia Hills.
Phoebe cooperiana, Das ...	*Mekhai*...	North East Frontier, Sadiya.
54. *Phoebe goalparensis*, Hutch.	*Nikahi* ...	Goalpara, Balipara Frontier Tract.
55. *Pinus insularis*, Royle	*Dieng kseh* Khasi.	Darrang and Khasi and Jaintia Hills.
Podocarpus neriifolia, D. Don.	*Kath-bhalukv*, *Jinari.*	Khasi and Jaintia Hills, Lakhimpur, Cachar, Mikir Hills.
66. *Talauma phellocarpa*, King.	*Khorikhasopa*	Lakhimpur, Sibsagar, Nowgong, Khasi Hills, Cachar, Garo Hills.
Taxus baccata, Linn ...	*Dieng-bl e i* Khasi.	Khasi Hills.
71. *Terminalia myriocarpa*, Heurck, Muell.	Hollock ...	North-East Frontier, Lakhimpur, Nowgong, Sibsagar, Khasi and Jaintia Hills, Cachar, Lushai Hills, Garo Hills, Goalpara and Balipara Frontier Tract.
Ulmus lancifolia, Roxb.	*Nanuk* ...	Garo, Khasi and Lushai Hills, Kamrup, Sibsagar, North Cachar Hills, Nowgong.
IV. Timber used for boat building		
10. *Amoora wallichii*, King	*Amari* ...	Fairly Common in Upper Assam, Balipara Frontier Tract, also in the Surma Valley.
12. *Artocarpus chaplasha*, Roxb.	*Sam* ...	Fairly common throughout the province.

Species	V. Name	Distribution
14. *Artocarpus lakoocha*, Roxb.	*Dewa* ...	Common throughout the province.
17. *Bombax malabaricum*, DC.	*Simul, Simolu*	Occurs sporadically in all sorts of forests throughout the province.
Careya arborea, Roxb. ...	*Kumbi* ...	Nowgong, Sibsagar, Darrang, Kamrup, Goalpara, Garo Hills, Khasi Hills.
24. *Cinnamomum cecidodaphne*, Meissn.	*Gonseroi* ...	Throughout the province.
Dysoxylum binectariferum, Hk. f.	*Bandardima*	Fairly common throughout the province.
38. *Lagerstroemia flos-reginae* Retz.	*Ajhar, Jarul*	Garo Hills, Kamrup, Nowgong, Sibsagar, Cachar, Darrang, Khasi Hills.
34. *Gmelina arborea*, Linn	*Gomari* ...	Common throughout the province.
45. *Michelia champaca*, Linn.	*Titasopa* ...	Occurs sporadically in all districts generally along the foot of the hills but not at all common.
50. *Morus laevigata*, Wall	*Bola* ...	Nowgong, Sibsagar, Lakhimpur, Darrang, Cachar, Goalpara, Garo Hills, Khasi and Jaintia Hills, North Cachar Hills, North-East Frontier.
60. *Shorea assamica*, Dyer...	*Mekai* ...	Lakhimpur and Naga Hills.
61. *Shorea robusta* Gaertn	*Sal* ...	Darrang, Khasi and Jaintia Hills, Goalpara, Kamrup, Nowgong, Garo Hills.
68. *Terminalia belerica*, Roxb.	*Bhomora* ...	Kamrup, Nowgong, Sibsagar, Lakhimpur, Khasi and Jaintia Hills, Cachar, Lushai Hills, Goalpara, Garo Hills.
Vitex peduncularis, Wall	*Ahui* ...	Goalpara, North Cachar Hills, Khasi and Jaintia Hills, Garo Hills, Kamrup.

V. Timber used for carts and cart wheels:

Species	V. Name	Distribution	Uses
1. *Acacia catechu* Willd.	*Khoir* ...	Sadiya, Darrang and Balipara Frontier Tracts, Kamrup, Goalpara.	Stocks and felloes of wheels and frames of carts.
5. *Albizzia odoratissima*, Benth.	*Hiharu* ...	Plains of Assam from Goalpara and Sylhet to Darrang, Khasi Hills.	Carts, axles, naves, spokes, shafts.
18. *Bridelia retusa*, Spreng.	*Kohir* ...	Goalpara, Garo Hills North Cachar Hills, Nowgong, Kamrup, Darrang, Sibsagar, Lakhimpur, Khasi and Jaintia Hills.	Bodies of carts, shafts & yokes.
38. *Lagerstroemia flosreginae* Retz.	*Ajhar, Jarul*	Garo Hills, Kamrup, Nowgong, Sibsagar, Cachar Darrang, Khasi Hills.	Spokes and frames.
58. *Morus laevigata*, Wall.	*Bola* ...	Nowgong, Sibsagar, Lakhimpur, Darrang, Cachar, Goalpara, Garo Hills, North-East Frontier, North Cachar Hills, Khasi and Jaintia Hills.	Shafts and spokes.
69. *Terminalia chebula*, Retz.	*Hilikha* ...	Darrang, Goalpara, Garo Hills, Kamrup.	Frames axles and shafts.
	VI. Timber used in contact with water:		
71. *Acacia catechu*, Willd.	*Khoir* ...	Sadiya, Darrang, Kamrup, Goalpara.	Well construction.
14. *Artocarpus lakoocha*, Roxb.	*Dewa* ...	Common throughout the province.	Do.
Barringtonia acutangula, Gaertn.	*Hijal* ...	Sylhet, Lakhimpur, Darrang, Nowgong, Kamrup, Khasi Hills, Garo Hills.	Do.
16. *Bischofia javanica*, Bl.	*Uriam* ...	Common throughout the province.	Do.
Eugenia jambolana, Linn.	*Kathi-jamuk*	Sylhet, N. Cachar, Goalpara, Garo Hills, Kamrup, Sibsagar, K. & J. Hills.	Do.
Salix tetrasperma, Roxb.	*Panibhe* ...	N. E. F., Lakhimpur, Darrang. Khasi Hills, Sylhet, Kamrup, Goalpara, Sibsagar, Nowgong.	Do.
70. *Tetrameles nudiflora*, R. Br.	*Bhelu* ... *Dhubong* ...	Throughout Assam ascending to nearly 2000'.	Well curbs.

VII. *Timber suitable for veneers, piywood and panels*:

2. *Acrocarpus fraxinifolius.*
8. *Alstonia scholaris.*
10. *Amoora wallichii.*
12. *Artocarpus chaplasha.*
13. *Chukrasia tabularis.*
26. *Cynometra polyandra.*
27. *Dalbergia sissoo.*
30. *Dipterocarpus macrocarpus.*
45. *Michelia champaca.*
7. *Terminalia myriocarpa.*

VIII. *Timber suitable for matches.*

See page 20.

IX. *Timber suitable for packing cases*

	Ailanthus grandis	Borpat
11.	*Anthocephalus cadamba*	Roghu, Kadam.
8.	*Alstonia scholaris*	Satiana.
17.	*Bombax malabaricum*	Simul.
	Cryptocarya amygdalina	Bon-jholokia.
	Cryptocarya floribunda	Bon-hunalu.
32.	*Duabanga sonneratioides*	Khokon or Ramdala.
	Echinocarpus assamicus	Joba Hingori.
35.	*Hymenodictyon excelsum*	Bhinkendi.
	Kydia calycina	Pichola.
	Mangifera indica	Bon-am.
	Pterospermum acerifolium	Mora-goch.
	Pterospermum lanceaefolium ...	Moti-nahor.
	Sapium baccatum	Seling.
63.	*Sterculia villosa*	Odal.
64.	*Stereospermum chelonoides*	Pahari or Paroli.
70.	*Tetrameles nudiflora*	Bhelu or Tula.

Bamboos

Species	V. Name	Distribution	Utilisation
Arundinaria rolloona, Gamble.	...	Naga Hills ...	Characteristic the same as above ; nodes very much longer ; uses as above.
Arundinaria subercta, Munro.	*Namlang*, Khasi	Khasi Hills ...	Not thorny ; uses as above. Makes good fishing rods.

Species	V. Name	Distribution	Utilisation
Arundinaria hirsuta, Munro.	...	Khasi Hills...	A small species. May be used for walling.
Bambusa tulda, Roxb.	*Sieij-shken,* Kh ; *Mirtinga* Sylh ; *Masing,* Tipp ; *Jauthiwah,* Mech ; *Wage,* Garo ; *Sieid-skong,* Khasi ; *Wamili, Wamli,* Koch ; *Rongoite,* Kuki ; *Chekang,* Mikir ; *Jauthebant,* Ass.	Throughout the province.	Most common bamboo up to 70′ high and 4″ diameter ; used for all general building purposes, fairly durable ; also used for construction of temporary bridges.
Bambusa mana, wall.	*Pichli,* Sylh. *Mokal,* Ass.	Sylhet, Upper Assam.	Usually cultivated, uses as above.
Bambusa pallida, Munro.	*Wokthou,* Ass. *Sieid-shken,* Kh. *Jawabans,* Ass. *Washi,* Kach. *Wamalang,* Kuki.	Cachar, Khasi Hills, Sibsagar, North Cachar Hills.	A caespitose bamboo. Culms olive green ; used for general building purposes matting and basket making ; like B. tulda but not so durable.
Bambusa khasiana, Munro.	*Tyr-ah,* Khasi ...	Khasi and Jaintia Hills, Goalpara.	Solitary stemmed. Uses as above ; not very common.
Bambusa balcooa, Roxb.	*Waiong,* Kach. *Keppu,* Mik.	Khasi Hills, North Cachar Hills.	Up to 6″ diameter. One of the best species for general building purposes. Used for posts in Bengal for thatched huts.
Bambusa arundinacea, Willd.	*Kotabanh,* Kam. *Beru-bans,* Beng. *Wah-khanta,* Garo. *Teksido-arong, Cheksudo,* Mik.	Kamrup, Garo Hills, Nowgong	Thorny bamboo. Used for all sorts of purposes building, mats, baskets, etc.
Oxytenanthera nigrociliata Munro.	*Bulka,* Koch. *Kalia,* Sylh. *Wathibok,* Garo.	Garo Hills ...	A tufted bamboo. 30′-40′ long with a diameter up to 2″ ; nodes conspicuous; sometimes striped yellow. Used in building work and basket making.

Species	V. Name	Distribution	Utilisation
Dendrocalamus hamiltonii, Nees Arn.	*Kako-bans*, Ass. *Kekho*, Mik. *U Seit*, Kh ; *Pecha-bans*, Sylhet. *Roba-ro*, Tipp. *Khan*, *Khuawah*, Mech; *Wa-nod*, Garo.	Garo Hills, Kamrup, Nowgong. Khasi and Jaintia Hills Sibsagar, Lakhimpur, Sylhet, Goalpara.	Used for general purposes but not durable, splits ; but tea planters use for tea-house making ; very common.
Dendrocalamus hookeri Nees Arn.	*Sieid-iong* Kh. *Ussey*, *Ukotang* Ass.	Khasi Hills ...	Culms dark green with diameter up to 6". Used for water buckets and general purposes ; not common.
Dendrocalamus longispathus, Kurz.	*Khang*, Kach. *Unal*, Manip. *Ronal* Lush.	Lushai Hills, Sylhet.	Walls very thin. Used for building purposes ; not very common.
Pseudostachyum polymorphum, Munro.	*Bajal*, Ass. *Tulibanh*, Kam. *Wajinsa*, Kach. *Rowachalte*, Kuki.	Sibsagar, Kamrup, North Cachar Hills, Garo Hills, Lakhimpur	Thin walled shrubby bamboo with a characteristic sheath ; not very common.
Neohouzeana dullooa. A camus. *Teinostachyum dulloa* Gamble.	*Doloo*, *Ruathla*, Lush. *Wahadru* Garo ; *Dolubash*, Ass ; *Dongla*, Kh.	Lushai, Garo, Khasi and Jaintia Hill, Cachar, Sibsagar, Upper Assam Sylhet.	A tufted bamboo. 1-3" diameter, dark green, used for basket work and in building ; not very durable, soft tissued.
Teinostachyum griffithii Munro.	*Beti*, Ass. ...	Lakhimpur, Sibsagar and Khasi and Jaintia Hills.	A graceful straggling or subscandent bamboo ; wall thin ; used for basket work and to make pipes.
Cephalostachyum capitatum, Munro.	...	Khasi Hills...	Very well-known bamboo.
Melocanna bambusoides, Trin.	*Sylli*, Kh ; *Wahthri*, Garo ; *Wahsilh*, Garo *Mao*, Lush. *Mulibans*, Cach. *Tatsi-bans*, Beng. *Taraibans*, *Jharun*, *Wathi*, Kach.	Khasi and Jaintia Hills, Garo Hills, North Cachar Hills, Cachar, Lushai Hills, Sylhet.	Extensively used all over Surma Valley, Garo Hills and Bengal, for general building purposes such as matting, walling, roof structure and shingles. Recently the Engineering Department of the Assam-Bengal Railway has used creosote treated shingles.

THE FOREST RESOURCES OF ASSAM

CHAPTER I

Classes of Forests in the Province

Before proceeding to deal with the forest resources of Assam it is as well to give a brief description of the different categories and types of forests occurring in the province. In Assam there are three main categories of forests *viz.*, (*i*) Reserve Forests notified as such under the Assam Forest Regulation (*ii*) Unclassed State Forests which are lands at the disposal of Government and comprise areas which are neither Forest Reserves nor settled with any tenant for ordinary or special cultivation and (*iii*) forests owned by the various zemindaries in the province such as Bijni, Mechpara, Bogribari, Parbatjuar, etc., as well as forests included in the tea gardens and other *nisf-khiraj* and *lakhiraj* grants.

(*a*) *Reserved Forests.*—Of these three categories of forests only the first named are intensively managed by the trained staff of the Forest Department and only these are being worked under carefully compiled Working Plans with the object of a sustained perpetual yield of timber and minor forest produce.

Reserved Forests also have another function as protective forests, that is, no sustained yield is looked for but they are maintained to prevent soil erosion and floods and to conserve water supplies. Assam is very short of this type of Reserved Forests.

(*b*) *Unclassed State Forests.*—The Unclassed State Forests are theoretically under the control of the Forest Department but no intensive system of management with the object of a sustained perpetual supply of timber or other produce from them has been possible although as regards such of these areas as contain a good stocking of *sal*, some attempt has been made to prevent wholesale destruction by declaring these to be reserved trees which cannot be cut down or damaged and by exploiting them in rotation so that periods of rest are available for recuperation and growth

(*c*) *Indian State and Zemindari Forests.*—As regards the zemindari forests, the larger Estates such as Bijni, Manipur, Mechpara, etc., have engaged trained forest officers to manage their forests and while the situation is not as good as can be desired, some attempt is being made at proper forest conservation in the way of exploitation ; but funds are not usually forthcoming for the improvement of the growing stock.

Area of Reserved Forests

Assam has got only about 9·7 per cent. of its total area constituted as Reserved Forests as against 20 per cent. and more in countries with a proper forest sense such as the Scandinavian countries in the west and Japan in the east. The total area of Reserved Forests in Assam (including 77,650 acres of Protected Forests in Sadiya) is 6,514 square miles. This area is quite insufficient especially in view of the large percentage of hill country in Assam.

Existing Unclassed State Forests are being jhumed extensively, have been and are being rapidly taken up for cultivation by immigrants from Bengal as well as the indigenous people and are deteriorating rapidly under uncontrolled exploitation of forest produce given free to settlement holders and by grazing. It is therefore, only a question of time before this type of forest is wiped out.

Administration

For purposes of administration the forest areas are at present divided into 11 units called Divisions administered by trained gazetted officers of the Imperial and Provincial Forest Services. These charges are :—

1. Sadiya, 2. Lakhimpur, 3. Sibsagar, 4. Nowgong, 5. Kamrup 6. Garo Hills, 7. Darrang, 8. Kochugaon 9. Haltugaon 10. Sylhet and 11. Cachar.

In addition to these the forests of some of the "excluded areas" which come under the special responsibilities of the Governor of the province, such as the forests of the Khasi and Jaintia Hills and Lushai Hills are administered directly by the Political Officers of the district concerned with the assistance of subordinate trained forest officers. For purposes of silvicultural research the province has a combined Botanical Officer and Silviculturist of the Imperial Forest Service ; for purpose of compilation of Working Plans for the proper management of these forests, there is a Working Plans Division and for facilitating the marketing of forest produce a full-time Utilisation Officer is employed although at present only in a temporary capacity. The Conservator is assisted in the administration of his vast charge by a Personal Assistant who is a senior Imperial Forest Service Officer and is permitted to tour on behalf of the Conservator.* Subordinate to the Divisional Forest Officers are Range Officers in charge of Ranges which are territorial units. These Range Officers are trained forest subordinates. Ranges are again sub-divided into Beats which are manned by Forest subordinates such as Deputy Rangers, Foresters and Forest Guards. The Divisional Forest Officers of important Divisions have usually one or two junior gazetted assistants to assist them.

CHAPTER II

Forest types and main timber trees occurring therein.

Broadly speaking the following forest types occur in the province :—(*i*) *Sal* Forest, (*ii*) Evergreen Forest, (*iii*) Mixed deciduous forest, (*iv*) Pine Forest, (*v*) Riverain forest, (*vi*) Highland savannah and (*vii*) Lowland savannah.

(*a*) *Sal Forest.*—The principal *Sal* forests occur in the Kochugaon, Haltugaon, Kamrup, Garo Hills, Nowgong, Darrang and the Khasi and Jaintia Hills districts and there is a small patch of *Sal* forest in the Sylhet district. The total area of *Sal* Forests in the province is approximately 177,000 acres in the Reserves. The distribution of *Sal* forests in the Reserves among the Divisions is approximately as follows :—

Kochugaon Division	...	...	72,000 acres.
Haltugaon Division	...	...	32,000 ,,
Kamrup Division	...	...	42,000 ,,
Nowgong Division	...	...	3,800 ,,
Nongkhyllem Reserve	...	...	3,200 ,,
Garo Hills Division	...	...	23,000 ,,
Darrang Division	...	...	1,000 ,,
	Total		1,76,800

About two million four thousand c. ft. of *Sal* timber were exploited from the province in 1937-38.

*Since writing the above the post of a second Conservator has been sanctioned and the post of Personal Assistant abolished.

(*b*) *Evergreen Forests.*—Two types of evergreen forest have to be distinguished *viz.*, (*i*) Highland evergreen and (*ii*) Lowland evergreen.

Highland evergreen forests are very common in the Sadiya, Lakhimpur, Darrang, Sibsagar, Nowgong, Cachar and Sylhet Divisions, occur to a small extent in the Haltugaon Division, and only as scattered patches in other Divisions.

The principal species of value occurring in these forests are Hollock, Hollong, Cham, Amari, Gonseroi, Nahor, Bonsum, Gurjan and the Sopas and Sundis.

Lowland evergreen is common in all Divisions generally fringing the smaller streams and ravines and around 'bhils' and swamps. Very few important timber species of present utility occur in this latter type of forests, the only important one being Ajhar (Jarul) which however is itself deciduous. Species which with treatment and seasoning can yield useful timber, however, are very common in this type of locality ; such are *Dillenia indica* (Outenga) and *Bischofia javanica* (Uriam).

A characteristic feature of the evergreen forests in contrast with the *Sal* forests is the almost complete absense of gregariousness, there being rarely more than 10 to 15 trees per acre of the same species. However, even amidst this infinite variety, certain species tend to occur with good stocking over definite zones. Thus in Sadiya in the Brahmaputra series (Purkayastha's Sadiya plan) there is a predominance of Hollock and in the Dehing series Hollong. Again in the Lakhimpur Division, the foothills of the Naga Hills and the spurs leading from them have a predominant tree crop of Hollong and Nahor, these two species forming more than 20 per cent. of the crop while species such as Amari, Gonseroi, Hollock, Sam, Makai, etc., form less than 5 per cent. of the crop. In Purkayastha's zone II (*vide* page 14 of the Lakhimpur Plan) the predominant tree in sub-type (*a*) is Nahor which forms more than 20 per cent. of the crop. Similarly Mackarness (*vide* pages 7 and 8 of his Lakhimpur Plan) distinguishes areas where (1) Hollong and Nahor predominate (2) Makai and Nahor predominate and (3) Hollong and Jutuli predominate. Mohanlal describes a Bonsum type in his plan for the Nowgong and Sibsagar Reserves.

Coming to acreages the following are the approximate acreages of forests where the different species predominate :—

Hollock	...	...	7,000 acres	(Sadiya)
Hollong	...	...	3,000 ,,	(Other Divisions)

(It is also the predominant crop over considerable areas in the tract dealt with by Mackarness in his Plan).

Nahor	...	2,200 acres (Sadiya) (in mixture with Hollong). 5,583 acres (South Bank Lakhimpur) ; also occurs well stocked over considerable areas of the Hollong and Jutuli type forests dealt with by Mackarness in his plan. Also found predominating in large areas of the Central Range in Darrang.
Bonsum	...	13,248 acres (Nowgong 1st class with Bonsum). 3,000 acres (Haltugaon).

In addition large areas of the Reserves lying at the foot of the Aka and Dafla Hills in the Balipara Frontier Tract contain a predominant crop of this species.

Other species such as *Michelia montana*, *Michelia oblonga*, *Michelia manni*, *Manglietia insignis*, *Talauma phellocarpa* (Sopas) *Altingia excelsa* (Jutuli), *Cinnamomum cecidodaphne* (Gonseroi) etc , occur spordically and do not form in any way a predominant crop in any of the localities and hence they are not mentioned here. *Altingia excelsa*, however occurs in small pure patches in Lakhimpur, Sadiya and Sibsagar and is almost gregarious over limited areas in the Charduar, Balipara and other Reserves in the Balipara Frontier Tract of the Darrang Division.

(*c*) *Mixed deciduous forest.*—This type of forests in Lower Assam is generally found in highland adjacent to and surrounding *Sal* forests and in Upper Assam and the Surma Valley in admixture with evergreen forests ; there is no predominating species. The most common species in Lower Assam are *Schima wallichii* (Makria), *Lagerstroemia parviflora* (Sida), *Dillenia pentagyna* (Akshi), *Alstonia scholaris* (Satian), *Stereospermum chelonoides*, (Paroli), *Terminalia belerica* (Bhomora) and often *Bombax malabaricum* (Simul). Species such as *Schima wallichii* (Makria or Gugra) have useful timber qualities and the main defects they display as timber are due to lack of proper seasoning. Large quantities of these timbers are available and there is no reason why properly seasoned timber of this and other species should not replace timber at present called better class such as *Sal* and give a good profit to an enterprising timber man. *Terminalia belerica* and *Stereospermum chelonoides* are other timbers not at present in favour with timber merchants and which occur in fairly large quantities. Both these timbers are capable of yielding excellent treated sleepers and when properly seasoned yield reasonable timber for generally utility purposes ; the latter is however tough and hard to work. In this type of forest in the Mikir Hills, Sibsagar, Nowgong and Cachar is also found that excellent box-wood timber *Tetrameles nudiflora* (Bhelu) growing to gigantic dimensions. The timber has a ready demand in Calcutta and from favourable locations can be worked with great profit. Another good quality timber which is in fair demand in Calcutta and with the Railways is Haldu (*Adina cordifolia*). Large trees occur in the Garo Hills and Unclassed State Forests in Kamrup, Khasi and Jaintia Hills and Nowgong.

Another timber for which no practical use has been found at present is *Dillenia indica* which occurs in considerable quantities throughout the province.

(*e*) *Pine Forests.*—These are confined to the neighbourhood of Shillong and to certain of the ranges of the Naga and Lushai Hills, the Manipur State and the Aka country north of the Darrang district. Only the *Pinus insularis* forests in the neighbourhood of Shillong are commercially exploited and the annual outturn of about 2,000 tons finds a ready sale in Shillong. The forests are neither old nor extensive enough to start a resin-tapping industry at present.

(*f*) *Riverain Forests.*—Growing gregariously in this type of forest along the larger streams near the Bhutan Tract stretching from the Sankosh right up to the eastern boundary of the Darrang district are two very important species of present and potential value *viz.*, the Khoir and the Sissoo. There is an annual guaranteed supply of about 3,000 Khoir trees (from this tract) sufficient for a flourishing cutch boiling industry. As the technique is easy there is no reason why local enterprise should not be interested in this profitable industry. Sissoo is another timber which is sadly neglected

in the province although it is in universal demand in other provinces where it occurs. It is a magnificent furniture wood and its excellence for cart-wheels is too well known for mention ; it is also in demand by the Military Stores Department who pay excellent prices for good quality converted timber. While supplies are limited, for the turnover of business the profits will be good.

A list of trees of present and potential economic importance with their qualities, approximate quantities and localities from which they are available is appended to this note from which the business possibilities of the various kinds of timber will be available and the above remarks are only to exemplify the proposition that there are many trees with good timber qualities which await the enterprise of businessmen and investment of capital.

Other common trees in the riverain type of tract which have a fair demand now are *Duabanga sonneratioides* (Khokon) used for tea-boxes and planking and *Trewia nudiflora* (Pitali) an excellent timber for match-wood and packing cases.

Simul, a well recognised match-wood is ubiquitous in its occurrence in the mixed deciduous and riverain types. While supplies along river-banks are rapidly getting exhausted due to exploitation and loss by river erosion large quantities are available in mixed deciduous forests where the trees are not capable of exploitation because of the lead to floating streams. It will be sound business to consider whether siting of small factories in such localities will not be a profitable investment.

(g) Savannah Forest.—Highland and lowland savannahs are at present of little economic value from the point of view of their tree crop as the trees occurring in them are far too scattered ; and only Simul occurring in these tracts near floating streams is exploited.

Minor Forest Produce

The above description of the forests in Assam and their growing stock makes no mention of the minor forest produce occurring in them ; but three very important articles of minor forest produce are of great occurrence in these forests and yield considerable revenue to the Department, profit to businessmen and employment to the local population ; these are canes, bamboos and thatch. Ekra, nal, patidal, patidoi, limestone, lac, dhuna, pipul, gandhi, ivory, agar, etc., also yield some revenue and details are given in the next chapter.

CHAPTER III

MINOR FOREST PRODUCE

Canes

The principal canes that are exploited in the province are :—

Jatibet (Jalli)	...	...	*Calamus tenuis.*
Lejaribet ...	...	...	*Calamus floribundus.*
Raidang ...	...	...	*Calamus flagellum.*
Honkabet ...	...	...	*Calamus califotuis.*
Jangia ...	...	...	*Calamus erectus.*
Sundibet ...	...	...	*Calamus guruba.*
Gollabet ...	...	...	*Daemonorops jenkinsianus.*

By far the major proportion exploited consists of Jatibet and Legaribet. The principal sources of supply are the Sadiya, Lakhimpur, Sibsagar, Nowgong, Darrang and Cachar Divisions.

The following is a list of cane mahals at present existing in the province The quantities extracted and the revenue realised are also shown therein.

Statement of cane mahals in the province, with the quantity and value of cane extracted and revenue realised compiled from mahaldars' transit pass books :—

Outright sale

Mahal No.	Name of Division	Period of settlement	Sale price	Quantity of cane removed	
				Jati	Tita
1	Sibsagar ..	1st July 1936 to 30th June 1939	Rs.600 ..	125·257 kaps	..
2	Ditto ..	Ditto ..	Rs.300 ..	..	
4	Ditto ..	Ditto ..	Rs.7,500	10,33,380 caps	(Jati and Tita.)
10	Ditto ..	Ditto ..	Rs.2,785	12,727 bundles	1,269 bundles.
11, 12	Ditto ..	Ditto ..	Rs.1,277	..	..
13, 18 & 14	Ditto ..	Ditto ..	Rs.7,010 ..	22,747 bundles	561 bundles.
15	Ditto ..	Ditto ..	Rs.26,000	33,000 bundles	1,868 bundles.
16	Ditto ..	Ditto ..	Rs. 22,001	10,037 bundles	26,951 bundles.
I&II	Darrang..	1st April 1938 to 31st May 1939	Rs.1,200	14,950 kaps ..	20,450 kaps Laza and 23,025 kaps Raidang.
I	Nowgong	1st July 1936 to 30th June 1939	Rs.651 ..	23,800 bundles	..
II	Ditto ..	Ditto ..	Rs.955 ..	78,000 bundles	..
III	Ditto ..	Ditto ..	Rs.5,000	34,500 bundles	..
I	Sadiya ..	20th November 1938 to 31st August 1939	Rs.16,271	8,00,000, kaps	..
II	Ditto ..	1st September 1938 to 31st August 1939	Rs.17,501	600,000 kaps	..
IA	Lakhimpur	1st September 1938 to 31st August 1939	Rs.21,252	800,000 kaps	..
IB	Ditto ..	1st August 1936 to 31st July 1939	Rs.13,001	986,000 kaps	..
II& III	Ditto ..	1st July 1936 to 30th June 1939	Rs.68,359	4,151,000 kaps	..

Monopoly fee and royalty

Mahal No.	Name of Division	Period of settlement	Royalty per mura for										Monopoly fees Lump sum
			Sundi		Rangi		Jati		Horna		Goka		
1	Cachar ..	1st July 1938 to 30th June 1940.	0 2 6		0 3 0		0 3 0		0 5 0		0 6 0		Rs.255
2	Ditto ..	Ditto ..	0 2 6		0 3 0		0 3 0		0 5 0		0 6 0		Rs 255
3	Ditto ..	Ditto ..	0 2 6		0 2 0		0 3 0		0 5 0		0 6 0		Rs.255
4	Ditto ..	Ditto ..	0 1 6		0 2 0		0 2 0		0 3 0		0 3 0		Rs.625
5	Ditto ..	Ditto ..	0 1 6		0 1 6		0 1 6		0 2 0		0 2 0		Rs.150

Longai Valley	Sylhet ..	1st April 1938 to 31st March 1939	Quantity removed 1,44,830 r.ft. Jati	Royalty value 450 14 0	Rs.250
Ditto ..	Ditto ..	Ditto ..	1,26,023 r.ft.	39 6 0	Rs.74
Patharia Reserve.	Disto ..	Ditto ..	59,200 r.ft. Jati	18 8 9	Rs.5

Bamboo.—The principal bamboos that are exploited are :—(1) *Bambusa tulda* (Mertinga-Jati). (2) *Melocanna bambusoides* (Muli) and (3) *Bambusa balcooa.*

The first named is the one used extensively for constructional purposes in the Assam Valley. In the Surma Valley *Bambusa balcooa* is similarly used and was formerly exported in large quantities from Sylhet and Cachar to Calcutta for the manufucture of paper pulp.

Melocanna bambusoides which also occurs in fair amounts in the Sylhet and Cachar Divisions as well as the Garo Hills Division is extensively exploited for the manufacture of umbrella handles.

Teinostachyum dullooa (*Dalu*) is another bamboo which has a small demand in Cachar.

The most ubiquitous bamboo of Assam is the 'Kakua' or Kako bamboo (*Dendrocalamus hamiltonii*). Demand for it is purely local, the main consumers being the jungle tribes although small quantities are exported.

Other Minor Forest Produce

Patidal (Chatipet) *Licuala peltata* is another plant which occurs in lowland evergreen forests all over the province. In the Sylhet and Sibsagar Divisions it is exploited commercially on a small scale : about Rs.750 is realised annually by sale of mahals in these two Divisions.

Patidoi (*Clinogyne dichotama*) is extensively used in the province but is exploited commercially on a small scale only for the same reason as for patidal *viz.*, that settlement holders get this produce free for their domestic use from Unclassed State Forests.

Elephants :—Another important item of revenue for Government from the forests is royalty on elephants captured in kheddah and mela shikar operations. Rupees 30,000 to 50,000 are realised by Government annually under this head. Sale prices are low and consequently Government royalty, due to extensive hunting in the endeavour to give all owners of hunting elephants (kunkies) employment and to meet the demands of cultivators whose crops are being damaged. At the present rate of capture there is a heavy inroad into the stocks of wild elephants which is further increased by the number of rogues shot each year under control licenses and proclamations.

India Rubber (*Ficus elastica*) :—Plantations in the Charduar Reserve of the Balipara Frontier Tract and a small one at Kulsi in Kamrup used to yield considerable revenue about 30 years ago but the trade in this produce is now practically extinct.

Agar.—This produce from the Agar tree (*Aquilaria agallocha*) is another minor forest produce which yielded about Rs.6,600 in 1938-39. The principal agar areas are Sibsagar, Nowgong, Darrang and the Garo Hills but supplies are diminishing.

Lac from the lac insect (*Tachardia lacca*) bred in the Nowgong, Sibsagar, Mikir, Garo, Khasi and Jaintia Hills districts also furnishes a good amount of revenue. About 25,000 maunds of lac were removed from the forests of the province in 1938-39 and yielded a revenue of Rs.25,500. Lac has been the subject of a commission and re-organisation of collecting and cleaning methods are required so that it may compete with synthetic products.

Hydnocarpus (*Taraktogenos*) *kurzii*, a tree the seeds of which yield the chaulmugra oil of commerce is exploited mainly in Sibsagar and the North Cachar Hills of the Nowgong Division. The mahals in these two Divisions yielded a revenue of Rs.675 in 1938-39.

Strychnine.—Small quantities of the fruit of *Strychnos nux-vomica* which occurs sporadically in the North Cachar Hills and Nowgong are also exported from the province.

Pepper.—Another medicinal plant from which a certain amount of revenue is obtained is *Piper longum* (the long pepper, pipal) collection of which is made in the Nowgong and Darrang districts.

Dhuna (*Canarium resiniferum*) is another sporadic tree which yields the resin called ' dhuna ' for which mahals are functioning in Nowgong and Sibsagar. The Sibsagar mahal yielded only Rs.50.

Soap oil.—The fruit of the Nahor tree (*Mesua ferrea*) has recently come into prominence as yielding an excellent oil for soap making, but it has not yet been found possible to eliminate the colour and odour.

Gutta percha (*Palaquium polyanthum*) is a tree fairly common in the Cachar Division which yields gutta percha and the Forest Utilisation Officer is endeavouring to improve the market for this commodity.

Simul cotton is exploited on a small scale in Sadiya and Sylhet ; the quantity exploited in Sadiya in 1938-39 was about 40 maunds while a cotton mahal in Sylhet yielded Rs.155.

Gurjun Oil.—*Dipterocarpus turbinatus* occurring in Cachar is a tree from which the gurjun oil of commerce is capable of being extracted.

Tezpat.—*Cinnamomum tamala* is a tree common in the Khasi Hills and occurring to a certain extent in Sylhet and Tipperah which yields a substitute for the real ' tezpat ' of commerce and is a minor forest produce of some importance.

Insecticides.—*Derris ferruginea and Milletia pachycarpa* are two plants of fairly common occurrence, the latter especially being very common in *sal* forests, which are coming into importance as affording the raw material for insecticides.

Myrobalans.—*Terminalia belerica* and *Terminalia chebula*, the former very abundant all over the forests of the province, yield the myrobalans of commerce and if a good collection agency is organised the trade in these should yield profits.

Fibres.—Among fibre-yielding plants, *Sterculia villosa* which yields a very coarse fibre, *Boehmeria nivea* and *Villebrunia integrifolia* are the only ones of any importance ; the last mentioned plant yields an excellent fibre but its occurrence is very scattered.

Gums.— Various plants such as *Sterculia villosa* and *Albizzia procera* are trees which yield gums ; but the economic importance of these gums at present is negligible.

Medicinal plants.—There are about 2,000—3,000 species of plants occurring in the province which are reported to be useful in indigenous medicine but only those which have been found to be useful according to research officers following the western system of medicine have been mentioned below :—

Mishmi Teeta.—*Coptis teeta* (or mishmi teeta) which occurs in the Mishmi Hills and the Assam-Burma border is a plant of some importance medicinally as a tonic.

Vasecin.—*Adathoda vasica*, an undershrub in some forest tracts yields vasecin which is useful medicinally for the treatment of asthma.

Holarrhena antidysenterica is a plant often found in mixed deciduous forests as undergrowth, which yields a drug reputed to be a specific for dysentry.

Alstonia scholaris.—The bark of this plant is reputed to be useful for the treatment of malaria.

Sida cordifolia is a common undershrub in the forests yielding a drug useful for diseases of the nervous system.

Vitex peduncularis.—The utility of an infusion of the leaves of this plant as a febrifuge is now denied by competent research workers.

Quinine.—Mention must also be made of the exotic, *Cinchona succirubra*, *ledgeriana* etc., which yield the drug quinine. They have been successfully raised in experimental plantations which have shown the possibilities of their cultivation in sites above 1,500′ in elevation.

Gandhi.—(*Homalomena rubescens*) is another medicinal plant yielding an essential oil. It yielded a revenue of Rs.17 in the Sylhet Division in 1938-39.

Honey and Bees' wax were exploited from the province to the extent of 314 maunds worth Rs. 814 as royalty and mahals in Nowgong and Sylhet fetched another Rs.400 in 1938-39.

Reeds.—About 200,000 bundles of reeds were extracted on payment from the forests in the province and yielded about Rs.1,300.

Stone.—Amount 60,000 c.ft. of stone were removed on payment and the revenue realised was about Rs.2,000 ; in addition the Sylhet stone mahal fetched Rs.225 in 1938-39. Stone is extracted free for public purposes while the Railways pay annually for the quarries they hold.

Limestone.—20,460 c.ft. of limestone were extracted in 1938-39 from Sylhet and fetched a revenue of Rs.1,000, while for the mahal in the Khasi and Jaintia Hills the monopoly fee realised alone amounted to Rs.5,000.

Certain concessions have been recently granted for the manufacture of cement in the province and the business in limestone is thus likely to improve.

Sand.—1,125,000 c.ft. of sand were removed from the Reserves and Unclassed State Forests on payment and fetched a revenue of about Rs.3,000 in 1938-39.

Driftwood mahals—These also fetch a certain amount of revenue annually.

Fuanal resources.—It is not proposed to deal with the fuanal resources of the forests of the province. As stated before considerable revenue is realised by the capture and sale of elephants. Ivory also yields fair revenue annually as also rhino and deer horns, etc. and shooting and fishing permits.

Shooting and fishing permits in the Reserves may be obtained on payment from the Divisional Forest Officer concerned and blocks of forests may be reserved for shooting by application to the Conservator of Forests through the Divisional Forest Officer concerned. The fees are :—

Class II Shooting licenses are issued for one year or less, expiring on the 31st May at Rs. 20 each.

The following royalties for animals wounded or killed are payable in addition to the above license fee : other animals and birds not mentioned are free of further fee :—

B
- Bull buffalo—Rs.100 for the first and Rs.200 for the second.
- Bull Bison—Rs.50 for the first and Rs.100 for the second.
- Full grown male sambhar—Rs.15 for the first and 30 for the second.
- Full grown male swamp deer—Rs.30 for the first and Rs.60 for the second.
- Full grown male barking deer—Rs. Nil for the first two and Rs.10 for each subsequent one.
- Full grown male spotted deer—Rs.35 each.
- Full grown male hog deer—Re. Nil for the first two and Rs.10 for each subsequent one.

Class I shooting permits —In addition to the Rs. 20 payable for a shooting license as in Class II permits the following fees are payable for reservation of each class I Block for periods of 15 consecutive days :—

	Rs.
(*a*) One holder of a license	25.

(*b*) A party of holders of licenses not exceeding 6 in number :—

Number of licenses	Scale of fees. Rs.
Two	20 each
Three	15 ,,
Four to six	12 ,,

In addition to the royalties stated at B which are payable both in Class II reserves and Class I blocks, the following royalties are payable for Class I blocks :—

Full grown male barking deer—Rs.5 for the first and 10 for each subsequent one.

Full grown male hog deer—Rs.5 for the first and 10 for each subsequent one.

Tiger or tigress—Rs.25 each.

Licenses in Form B to fish in reserved forests except sanctuaries are issued on payment of the following fees :—

For one day	Re. 1
For one month...	Rs. 10
For two months	,, 20
For one season...	,, 30

CHAPTER IV

GRAZING AND FODDER

Analysis of figures collected in different Divisions reveals that approximately 20,000 buffaloes, 35,000 cows and bullocks and about 200 goats and sheep are annually grazed in the Forest Reserves of the province. Of these numbers only less than 50 per cent. are grazed on payment of either full or privileged rates of grazing. The rest are either grazed free by forest villagers or by settlement holders who have rights of free grazing. About Rs.35,000 is realised by the Department as grazing fees. It is not possible to give the figures regarding the incidence of grazing in the Unclassed State Forests of the province as these are under the control of the Civil authorities. 2,447 square miles of Reserves are at present open to grazing. Out of these areas the actual localities where grazing take place are mainly in the neighbourhood of villages so that the per acre incidence of grazing calculated on the basis of total acreage available and total numbers grazed will give a purely illusory picture.

In the case of professional graziers and where grazing incidence is high rotational grazing schemes are in vogue based on an incidence of grazing of 7 acres per buffalo and 2 acres per cow and in two of these areas improvement schemes are followed under the control of the Live-Stock expert to the benefit of the cattle of Assam as a whole and the pockets of the graziers themselves in particular. It is to be noted that all the Reserved Forest areas of this province are not suitable for grazing due to undergrowth conditions. Consequently, to look ahead, methods and rules are required for the limitation of useless cattle and for stall feeding. The Forest Department can help by increasing fees on useless cattle and providing areas for cutting of fodder for stall feeding and in particular by providing land in forest plantations where fodder grasses can be grown between the plant lines. Sale of fodder realised only Rs. 44 during the year ; consequently there is a large opening for a business that will provide fodder for stall feeding particularly to the towns. This is an important necessity as grazing is not good for forests generally and we have to incur expenditure in fencing regeneration areas from such grazing.

CHAPTER V

PRESENT METHODS OF EXPLOITATION

The general method of disposal of timber is by auction or tender for the working of coupes marked under Working Plan prescriptions in accordance with silvicultural principles.

The Forest Department does not usually undertake departmental exploitation. It has however become increasingly apparent in recent years that local traders if left to themselves do not study market conditions with the result that in the case of the *Sal* market due to excessive cutting of logs, stocks have increased beyond market absorption and prices have seriously fallen.

This has been principally due to failure to cut sleepers, for which there is a steady demand, owing to a dislike by local traders of this form of conversion.

It has therefore become necessary for the Department to step in and rehabilitate the market by obtaining sleeper contracts on tender from Railways at specified prices and then allotting these contracts to sub-contractors with the stipulation that out of each coupe they purchase at coupe-auctions a specified number of sleepers will have to be cut. Considerable quantities of timber have and will thus be converted in the form of sleepers so that these timber which would have gone to glut the log market will now go to the Railways.

Another advantage derived by the department taking up sleeper supply is that smaller contractors will have a share in the sleeper business from which they were being steadily ousted by bigger businessmen who were on the approved list of the Sleeper Pool and who could thus control sleeper prices.

Other timber species of more or less gregarious occurrence are sold as coupes outright but where they are of scattered occurrence like *Bhelu* and *Simul* covering large tracts they are sold on the monopoly-*cum*-royalty system with c.ft. rates of royalty on the outturn.

In the Sadiya and Lakhimpur Divisions, where two companies have established veneer mills for the manufacture of plywood tea-boxes of Hollock and Hollong timber respectively, the forests are worked under company leases and output is controlled by Working Plans.

Minor forest produce such as cane and thatch is sold for the most part on the outright sale system in Mahals, and largely exported from the province under transit passes issued by the Department ; approximately 75 per cent. of the cane finds its way to the Calcutta market.

Royalty rates for such produce as lac, rubber, elephants, etc., are fixed from time to time and royalty is realised at these rates. Elephants are caught by two methods (*i*) Kheddah and (*ii*) Mela shikar ; both operations are subject to supervision and control by the Department.

The kheddah method is that of rounding up herds into a stockade and this results in the capture of *all* sizes of elephants. The mela method is for trained elephants to chase and noose wild elephants and generally only the smaller ones are captured.

CHAPTER VI

MEANS OF EXTRACTION AND EXPORT

Rivers.—The main agency for extraction for all kinds of produce in the province is the Brahmaputra and its numerous tributaries. In the Kochugaon Division, the main floating streams are the Gorufela, the Gangia, the Longa, the Tipkai and Godadhar rivers ; in the Haltugaon Division, they are the Tarang, the Saralbhanga, the Champamati, the Monas and the Aie rivers. In North Kamrup only the Monas, the Mora Monas and the Hakua are of

any importance. In South Kamrup the principal streams the Kulsi, the Singra, the Singwa and the Bata are all used for floating timber during certain season of the year. In the Garo Hills, the principal streams used for floating are the Dudnai, the Krishnai, the Someswari (Simsang) and to a certain extent the Jinjiram, the Ildek and other smaller streams. In the Nowgong Division rafts are brought down the Kopili, the Doyang and the Kolong rivers ; the Borpani, the Jamuna and the Dhansiri rivers though suitable are seldom used. In the Sibsagar Division apart from the Brahmaputra itself there is little water transport except in the Doyang and Dhansiri which are used to a minor extent. In the Lakhimpur Division, the Dangori and Dibru rivers along with the Brahmaputra itself are used for extraction to Dibrugarh and lower down. The Burhi-Dehing river is also used for extraction of forest produce. The principal floating streams of Sadiya are excluding the Brahmaputra itself, the Dihang, the Dibang, the Lohit and the Poba which are useful for this purpose to varying extents during different seasons of the year. The Bhoreli is the principal floating stream of the Darrang Division while other streams such as the Nunai, Dhansiri, Sapai Belsiri, Borjan and Buroi can be used in certain periods in the rains.

As regards the Surma Valley, in the Cachar Division, the principal floating streams are the Katakhal, the Lalachera, the Kukichera, Dholai, Rukni Sonai, Barak and Jiri rivers. The Dalu, Jatinga, Larang, Goma and Dahuni rivers which drain into the Barak are floatable during flood time in the rainy season but such floating is precarious. The Barak river from Cachar branches into two streams *viz.*, the Surma and the Kusiara below Fadarpur and these two rivers which again unite and ultimately join the Meghna in Bengal are the two main floating streams of the District. The tributaries of the Kusiara such as the Singla, Longai, Juri and Mahu and the tributaries of the Surma and the Gowain and Pujan are also suitable.

The major part of the *Sal* timber produced in the Kochugaon, Haltugaon, Kamrup and Garo Hills Divisions is floated down the Brahmaputra to markets in East Bengal for sale.

Simul, Bhelu and other box-wood timbers are floated down from Upper Assam Divisions to Serajgunj on the Brahmaputa and from Upper Assam are carried by steamer down the Brahmaputra to Calcutta and East Bengal districts.

Bamboos and timber are floated down to the Meghna and then to East Bengal districts from the Surma Valley ; some converted timber from the same area is carried by steamers.

Tramways.—The forest tramway of the Kochugaon Division serves as the main line of transport for the major part of the timber coming from the Reserves of the Division except the Guma Reserve. The tramway has 43 miles of 2' guage track, about 17 of which from Kochugaon to Fakiragram serves purely for transport of timber, while the remaining track serves both for extraction of timber from the forests and for the supply of water to forest employees and labourers working in the waterless tract. The tramway has at present 4 steam locomotives of 20-30H.P., about 71 pairs of steel log-trucks for the transport of timber, numerous water-trucks for the transport of water and certain number of ballast tip-trucks. An average of about 800 c.ft. of timber can be transported in one train trip although it has been calculated that loads as heavy as 1,250 c.ft. can be transported per trip if the rolling-stock, the track and the loco-staff are kept in a high state of efficiency. The forest tramway carried 234,000 c.ft. of timber in the year 1938-39 and gained a revenue of Rs.55,712 against an expenditure of Rs.30,007.

In addition to the Kochugaon Forest Tramway maintained by the Department, the Assam Railways and Trading Company maintain a short line of metre guage track for their extraction work in the Lakhimpur Division and the Assam Saw Mills and Timber company have a narrow guage track similarly in the Sadiya Division.

Railways.—The Assam-Bengal Railway is used by many Divisions for the transport of forest produce. Many of the Nowgong Reserves are very favourably situated as regards transport of timber and other forest produce by the main and branch lines of this Railway system. As regards the Reserves in the Sibsagar and Lakhimpur Divisions dealt with by Mackarness in his plan he remarks as follows :—" The Assam-Bengal Railway from Titabor to Naharkatiya runs parallel to the Reserves included in the Working plan area and consequently forms the main line of export ".

As regards Cachar the following remark is made in the Working Plan :—" The Assam-Bengal Railway main line serves the area from Silchar town to Badarpur and the hill section from Haranganj to Badarpur, but only a limited amount of forest produce is sent by it ".

In the Sylhet Division the following Railway systems are used to a certain extent for the transport of produce :—

The branch lines of the Assam-Bengal Railway as follows :—

(*a*) Habiganj Bazar, Shaistagunj-Balla line.

(*b*) Kulaura-Sylhet Bazar line.

(*c*) Karimganj junction-Dullabchera line *via* Baraigaon junction.

(*d*) Karimgang junction-Kalighat line *via* Baraigaon junction.

As regards the Eastern Bengal Railway, there is a small amount of transport of timber from the Kokrajhar and Fakiragram stations to Sapatgram station and recently between Dhubri and Sapatgram. Sleepers passed at Pandu, Sapatgram, Fakiragram, Tipkai, etc., are transported by the Railways themselves to their various destinations.

Elephants purchased by Behari ' Sadagars ' are also transported by the Assam-Bengal and Eastern Bengal Railways to their destinations.

Considerable quantities of lac and other minor forest produce are also transported annually by the Assam-Bengal and Eastern Bengal Railway systems.

Motor Transport.— The larger lessees of forests in the Garo Hills and Khasi Hills (and till recently in Kamrup) employ motor-lorries for transport of their timber to floating streams or to places where sleeper passing takes place. Thus the Dambu, Darugiri and Songsak Reserves as well as certain Unclassed State Forests in the Garo Hills are being exploited by means of motor lorries as also the Nongkhyllem Reserve in the Khasi Hills and till recently the Gorbhanga Unclassed State Forests in Kamrup.

Motor tractors and trailers are now being utilised by the Assam Saw Mills and Timber Company in the Sadiya district

Elephants.—Elephants are employed to a fair extent for extraction in the province ; they are mainly employed for dragging logs from the felling site to the nearest floating stream or other means of extraction as in Sylhet and Cachar. Thus in Kamrup they are used to drag down timber from hill areas of the Kulsi drainage to the Kulsi river. In the Mikir Hills tract of the Sibsagar Division they are employed for dragging large Bhelu logs from the hill areas, where gigantic trees occur to the numerous tributaries of the

Brahmaputra. The Timber Companies working in Lakhimpur and Sadiya keep in employ a number of elephants for extraction of large-sized Hollock, Hollong, etc.

Buffaloes.—These animals are extensively used for extraction of sleepers and small sized logs and posts in the Kochugaon, Haltugaon, Kamrup, Nowgong and Garo Hills Divisions. Local as well as Manipuri buffaloes with their herdsmen thus find large scale employment under forest contractors. The lead generally may be anything up to 3 or 4 miles. Dragging costs about four annas per c. ft. of sawn material.

Bullock and Buffalo carts.—These means of extraction probably come only second to water-transport in importance. When there is no water-transport dragging is done to the nearest cartable road or track and the forest produce then transported to the main depots by buffalo and bullock carts except in the case of large lessees who employ motor lorries. Thus this primitive means of transport plays an important part in the economy of forest exploitation. The ordinary rates are about 1 anna per c. ft. for 3 miles though the rates fluctuate to a certain extent. Unfortunately the loose and narrow wheels of these carts do immense damage to the roads and a wider tyre and better axle bearings would result in less damage and consequently less cost of upkeep of roads and be a lighter burden to the buffaloes or bullocks. The new pneumatic tyre for carts is a great step forward and if cartmen would put down the larger amount of initial costs they would be quickly recompensed by increased loads and the better condition of their draught animals. There is thus a large field of employment in providing such wider type wheels and axle bearings.

CHAPTER VII

METHODS OF CONVERSION

The main methods of conversion as regards *Sal* timber are into logs, posts and sleepers. Felling and conversion into logs and posts are generally done by local labour while sawing into sleepers is generally undertaken by imported Nepalies and Gorakhpuris. The former use the pit-saw and have to prepare saw pits to which the tree sections are rolled or dragged and then hoisted on to the sawing platforms. Gorakhpuris on the other hand saw the tree sections in situ with their cross-saws and are much more expeditious workers than the Nepalis. Sawing costs about 6 annas per c. ft. Logs and posts are converted at the felling site. The conversion consists in dressing the trees into sections of convenient lengths almost down to heartwood. Better dressing is done in Kamrup than in any other Division. Dressing costs annas 0-1-6 to annas 0-2-6 per c. ft.

As regards species such are Bonsum, Titasopa, etc., conversion is usually done in the forest into planks and scantlings. The market prices for these vary between Re.1-2-0 and Re.1-8-0 ordinarily.

Hollock in Sadiya is converted into veneers by the Assam Sawmills and Timber Company for the manufacture of plywood tea boxes ; about 500,000 c. ft. are utilised annually.

Hollong is similarly converted by the Assam Railways and Trading Company in Lakhimpur to the extent of about 350,000 c. ft. annually.

Simul, *Cryptocarya floribunda*, *Ailanthus grandis*, etc., are converted in certain amounts by the Ghorania Sawmills in Lakhimpur. Simul from the province is also extensively used for match manufacture by the Dhubri Match Factory.

The Surma Valley Sawmills at Bhanga converts annually about 30,000 tons of hard and soft wood and export principally to Calcutta.

Bamboos intended for transport by railway or steamer to the paper mills in Calcutta are cut into short lengths, split, dried and bundled but as explained later, freight is crippling this trade as bamboos can be obtained nearer the present mills at cheaper rate. The remedy is a mill in Assam near the source of raw meterials—bamboo, grass, coal and lime.

CHAPTER VIII

MEASURES NECESSARY FOR THE BETTER UTILISATION OF THE FORESTS

Four important projects, if undertaken, will help to augment the revenues of the province by better ulilisation of the forests of the province.

(*a*) *Resuscitation of the Naharkatya treatment plant.*—This treating plant was put up in 1929 for creosote pressure treatment of mixed hardwood sleepers on the recommendation of the Sleeper Inquiry Committee of 1923-25. The plant continued to function till November 1934 when it was closed down as the price of naturally durable *Sal* had fallen so low that it was found that creosoted sleepers could not compete economically with the more durable untreated hardwood sleepers. *Sal* sleeper prices have risen to a certain extent but owing to the fact that most of the *Sal* forests of Nepal, the Indian States and the larger Zemindaries are worked with no controlled exploitation (which will in the course of time exhaust *Sal* trees) these agencies are still able to undercut prices quoted by the Forest Department ; thus the prices of *Sal* sleepers are not likely to range apparently higher for some years. The cost of creosote which was one of the principal items of the cost of treatment may, it is hoped, be reduced, in spite of the War, owing to the commencement of production of this material in India. Favourable prices can probably be obtained from these indigenous firms for steady supply.

Again it must be remembered that iron and steel sleepers compete with wooden sleepers in India but it would be sound policy now to open the plant again and produce treated sleepers against the day when uncontrolled fellings in Indian States and Zemindaries have exhausted the supply of *Sal* sleeper trees and left a much smaller yearly outturn from forests managed under Working Plans.

During the period that the plant functioned more than a million sleepers or a million and a half c.ft of timber were treated, the main supplies coming from the Lakhimpur and Sibsagar Divisions.

Mackarness in his plan for certain Reserves of the Lakhimpur Division mentions the royalty value per such sleeper as varying from 1 anna 6 pies to 9 annas per sleeper. Calculating an average royalty of 5 annas per sleeper, total royalty value of the sleepers treated in the plant works out to Rs.3,12,500. Since this royalty value was distributed over a period of 6 years the annual loss to the Lakhimpur and Sibsagar Divisions owing to the closing down of the plant is about Rs.50,000, a not inconsiderable sum.

From the foregoing it will be seen that the Department stands to gain an amount of about Rs.50,000 annually by the resuscitation of the plant.

A proposal for the resuscitation of this plant has been mooted and during the year a joint local investigation of the possibilities was made by the Joint Timber Advisory Officer of the Railway and Defence Departments, the Sleeper Control Officer, Eastern Group and the Forest Utilisation Officer of the province. The main obstacle to re-opening the plant is question of the price which the Local Railways are prepared to pay and it appears at present unlikely that, until *Sal* prices have further increased, an economic rate for treated sleepers will eventuate ; but as pointed out previously the opening is desirable now for the sake of experiment and for being prepared for the future.

Over and above the utilisation that can be effected in Upper Assam by the resuscitation of the plant two important species of Lower Assam, *viz.*, *Schima wallichii* and *Lagerstroemia parviflora*, large supplies of which are available, also treat well and yield good sleepers. One hundred and seventy-seven sleepers of these species were treated with coresote and crude oil at the Forest Research Institute, Dehra Dun and laid in a heavily worked portion of the Eastern Bengal Railway in 1921. The defects so far developed are rail-cutting and splitting but only 5 sleepers out of 177 have had to be changed during the course of 14 years.

(*b*) *Paper.*—Another important development which will benefit the proper exploitation of the forests of the province would be the establishment of a paper mill in the Surma Valley for the manufacture of paper from bamboo from the Cachar and Sylhet districts and from Hill Tipperah. The Forest Utilisation Officer remarks as follows :—"From a preliminary investigation it appears that within the province, approximately 2,52,000 acres are covered by not less than 25 varieties of bamboos of which Muli (*Melocanna bambusoides*), Kako (*Dendrocalamus hamiltonii*), Khang (*Dendrocalamus longispathus*), and Mirtenga (*Bambusa tulda*) predominate and are therefore important from the pulp industry point of view". While considerable areas out of these have no water facilities for floating of bamboos, the same officer remarks that "about 56,000 tons of bamboos can be made available for annual supply, provided pulp making factories are established at suitable centres within or in the vicinity of sources of supply". The best site for such a factory would, of course, be in the Surma Valley on the bank of the Barak, the Surma or the Kusiara because the most suitable kinds of bamboos for paper pulp, *viz.*, *Bambusa tulda* and *Melocanna bambusoides* occur most plentifuly in this tract. In addition to the above about 8 million bamboos mainly *Melocanna bambusoides* are annually extracted from the Garo Hills district.

Mr. N. N. Das, the Divisional Forest Officer, Sylhet, has the following interesting information to supply in this regard in his working plan for the Sylhet Division :—Bamboos are cut in the forests, rafted to Karimganj and Bhanugach Railway stations and carted to Chunarighat Railway station. They are taken cut into pieces 6′ long and split into 4 pieces, dried, made into bundles of 1½ maunds each and despatched by rail. On receipt the Company again dries a few bundles in steam and fixes the price of the whole consignment by the weight obtained. Weight thereby decreases usually by 10 to 27 per cent. It is found that Assam bamboos have 55 per cent. moisture whereas Bihar bamboos have only about 25 per cent.

The price of bamboos at Karimganj is Rs.20 to Rs.30 per 1000 and freight from Karimganj to Naihati *via.*, Santahar Re.0-7-6 per maund.

Cost per ton of bamboos from the Rajkandi Reserve to Naihati via., *Bhanugach Railway Station*:

	Cost per ton in 1935-36			Cost per ton in 1925-26		
	Rs.	a.	p.	Rs.	a.	p.
Cutting	8	0	0	12	0	0
Floating up to Bhanugach Railway Station.	1	8	0	2	0	0
Splitting etc.	1	8	0	2	0	0
Tying and loading	1	8	0	1	8	0
Cane	0	8	0	1	0	0
Railway freight	11	8	0	11	8	0
Royalty for 400 bamboos from the market.	0	8	0	1	0	0
Average loss in moisture	0	8	0	0	8	0
	25	8	0	33	0	0

From the foregoing it is apparent that out of a total cost of Rs.25-8-0 per ton for delivery at Naihati, the Railway freight itself amounts to almost half. By siting a factory locally this expenditure will be avoided. It might be argued that the finished pulp or paper will have to be transported back to Calcutta and other consuming centres so that the saving is not considerable, but in this connection it has to be remembered that one ton of pulp is produced out of 2¼ tons of bamboos so that the cost of transport of pulp will be only 45 per cent. of the cost of transport of the raw material and also that the Assam and East Bengal markets themselves are not to be scorned. For every ton of pulp produced the principal raw materials required are 2 tons of coal, 2¼ tons of bamboos, ½ a ton of lime and soda and ¼ of a ton of sundries. It is thus apparent that the factory must have ample supplies of coal and lime. Considering the siting of a factory in the Surma Valley from this point of view, the Jaintia Hills produce excellent lime in quantities. 1,83,358 maunds or 6727 tons of limestone were removed from the Unclassed State Forests of the province during the year 1938-39 mainly from the Jaintia Hills. Of course, the quantity at present extracted is only guided by the demand and there is no doubt that much larger quantities could be quarried provided a demand arises. Anyhow even with the present rate of extraction about 3,400 tons of paper pulp can be manufactured. Sylhet lime is well-known in the Calcutta market. The District Gazetteer of the Khasi and Jaintia Hills has the following remarks to offer:—"In no part of Bengal, or even Hindusthan, is the rock found so perfectly pure or so free of alloy as in this province".

According to the same authority "the total output in 1904 was about 12,300 tons of limestone. The lime quarries are situated all along the southern face of the hills from the Lobha river on the east to the Maheskhali river on the west".

The rock is brought to the banks of the nearest river and conveyed in small flat-bottom boats over the rapids to Chhatak. The lime is burnt all along the banks of the Surma river from Chhatak downwards, and as the bank of the Surma is a very favourable spot the location of a paper mill

owing to the facility it affords for the rafting of bamboos, it may be seen how advantageous it will be from the point of view of the limestone supply too.

As regards coal, this is also being quarried on a small scale in the Khasi Hills district and can be delivered to the factory at comparatively cheap rates.

The Laitryngew Mawsynram and Mawbehlangkhar coal fields in the district of Khasi and Jaintia Hills are described in the records of the Geological Survey of India, Volume XXIII, Part 3, page 120. The first named field is estimated by experts to contain about 1,000,000 tons of marketable coal. The second field is estimated to contain 52,000 tons of excellent coal and is the source from which Shillong gets its coal. The Mawlong coal fields are estimated to contain about 15 million tons of good workable coal. The Lakadon field situated a little to the east of Jaintiapur on two plateaus Unlotodo and Umngot is estimated to contain 116,000 tons. The Umngot field lies near the surface and the coal can be very easily quarried. The principal obstacles to exploitation up till recently have been difficulties of extraction to the plains but with the development of the fine motor road from Shillong to Sylhet and with the ropeway from Cherrapunjee to Chhatak extraction ought not to be difficult any more.

The quantities of bamboos avaliable in the two Divisions along the drainage of the Surma and the Barak have already been enumerated. In addition the hill section of the Assam-Bengal Railway taps extensive bamboo forests of the North Cachar Hills and with the prospect of large scale exploitation freights can be brought down to an economic level.

As regards utilisation of the grasses of the province for the manufacture of paper pulp, the principal grass of the savannahs is *Imperata cylindrica*. Extensive areas of such lowland savannah land occur on the banks of the Brahmaputra and on the numerous 'chors' (sand banks) in the river bed in the districts of Sadiya, Lakhimpur, Sibsagar, Darrang and Nowgong. The Utilisation Officer estimates that 100,000 tons of grasses mostly of the above species as well as ekra (*Erianthus spp.*) and Khagra (*Phragmites karka*) can be made available mostly from these localities. The quantities of thatch removed from the above 5 districts on permits from both Reserves and Unclassed State Forests amounted to 18,31,721 bundles of the royalty value of Rs.3,257 in 1938-39. In addition to this thatch mahals of the above 5 districts fetched a total price of Rs.14,487 ; calculating on this basis, another 82 lakhs of bundles of thatch are annually available from the Brahmaputra drainage area. Thus it will be seen that according to the present rates of extraction 10,000,000 bundles of thatch are annually available from this area. The nearest source of coal is the Lido coal mines in the Lakhimpur district and the Nazira coal mines in the Sibsagar district. Lime for any factory to be erected to tap this area will have to be imported, although the Divisional Forest Officer, Nowgong asserts that limestone quarries can be formed in his Division with floating facilities down the Jamuna river, should a demand arise.

In addition to the above, in the Surma Valley about 50 lakhs of bundles of thatch are extracted annually from the Reserves and the Unclassed State Forests. While all this quantity may not be available for a paper industrys any mill utilising bamboos will be able to get a proportion of this output a, a supplementary raw material.

The quantities have main reference to the grass *Imperata cylindrica*.

Raitt, the paper expert in his report on the investigation of savannah grasses as material for the production of paper pulp considered *Phragmites kakra* (Khagra) also as a species of major importance and considerable quantities of this grass are also available in the two areas above dealt with.

(*c*) *Match Manufacture.*—There are at present only 2 match factories of any size at present functioning in the province, namely the Assam Match Company's plant at Dhubri and the Jorhat Match factory's plant at Jorhat.

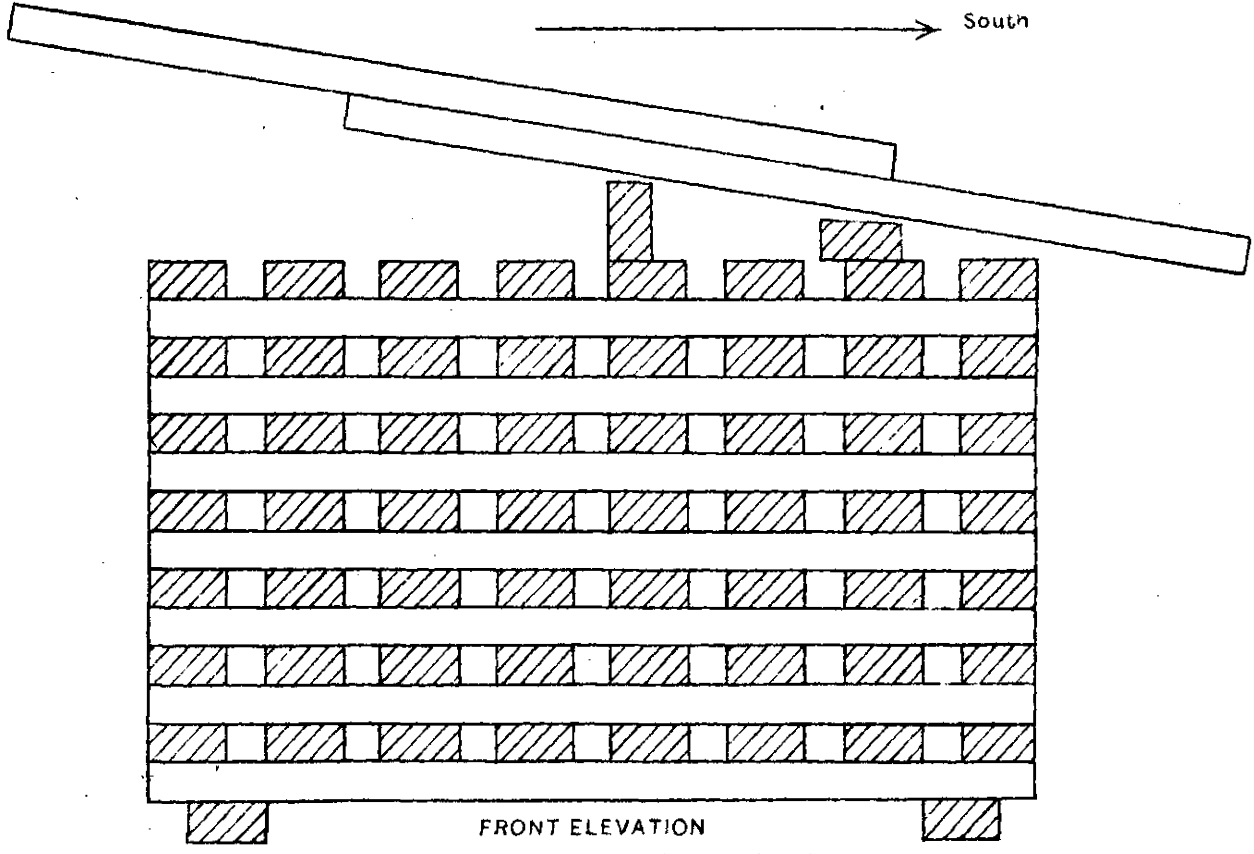
Assam has got the following timbers suitable for match boxes and match splints ; the quantities available and the localities from which supplies can be ensured as regards the principal species are enumerated under the detailed description of species appended to this note.

Scientific name	Vernacular name	Suitabilities for	
		Boxes	Splints
1. Bombax malabaricum	Simul ..	Good ..	Good.
2. Trewia nudiflora	Patali ..	Very Good..	Very Good.
3. Engelhardtia spicata	Lewa ..	Ditto ..	Ditto.
4. Anthocephalus cadamba.. ..	Kadam ..	Good ..	Good.
5. Alstonia scholaris	Satiana ..	Ditto ..	Ditto.
6. Kydia calycina	Pichola ..	Ditto ..	Ditto.
7. Hymenodictyon excelsum ..	..	Ditto ..	Ditto.
8. Dysoxylum binectariferum ..	Bandadima	Ditto ..	Fairly strong.
9. Trema orientalis	Fakdima..	Very Good..	Strong.
10. Bauhinia purpurea	Kernol ..	Fairly good	Fairly strong.
11. Evodia meliaefolia	Maiphak..	Good ..	Strong.
12. Pterospermum acerfolium ..	Moragoch	Fairly good	Good.

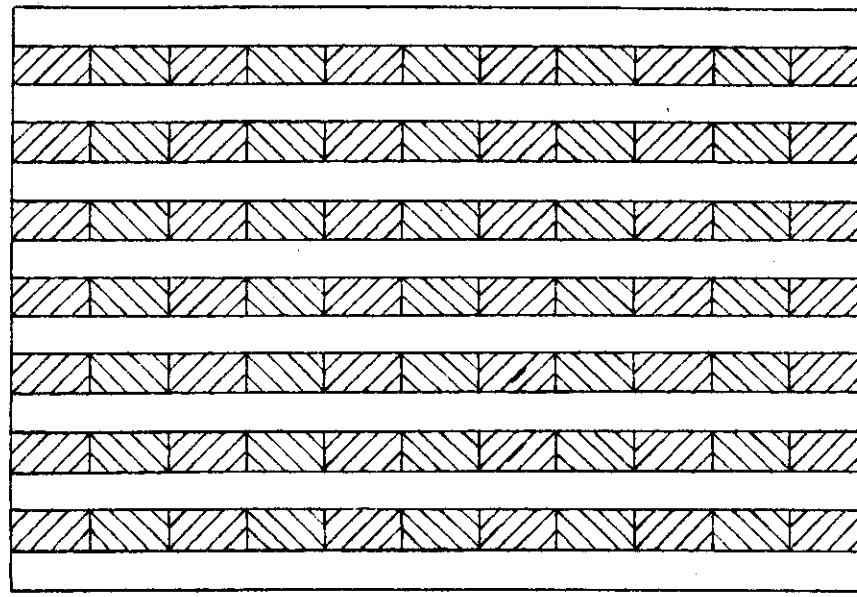
The quantities available in any particular area are limited and the scope in Assam now is for cottage factories with moderate output as against large sized factories. The policy of the Government of India at present is also to encourage small sized factories as they have given a preference to this type by levying 5 per cent. less excise duty on factories which manufacture less thad 100 gross of matches per day.

The total investment of capital required for a cottage match factory has been estimated as not likely to exceed Rs.25,000 inclusive of cost of sheds price of machinery and value of chemicals, wood, etc.

(*d*) *Seasoning Plants.*—The importance of proper seasoning of timber cannot be over-emphasised. Timbers used for furniture, panelling, sleepers, building construction, etc., are liable to rot, stain, surface-cracks, splitting, warping, shakes, etc., if they are utilised before proper seasoning. Many timbers of Assam now considered inferior in the province have this stigma

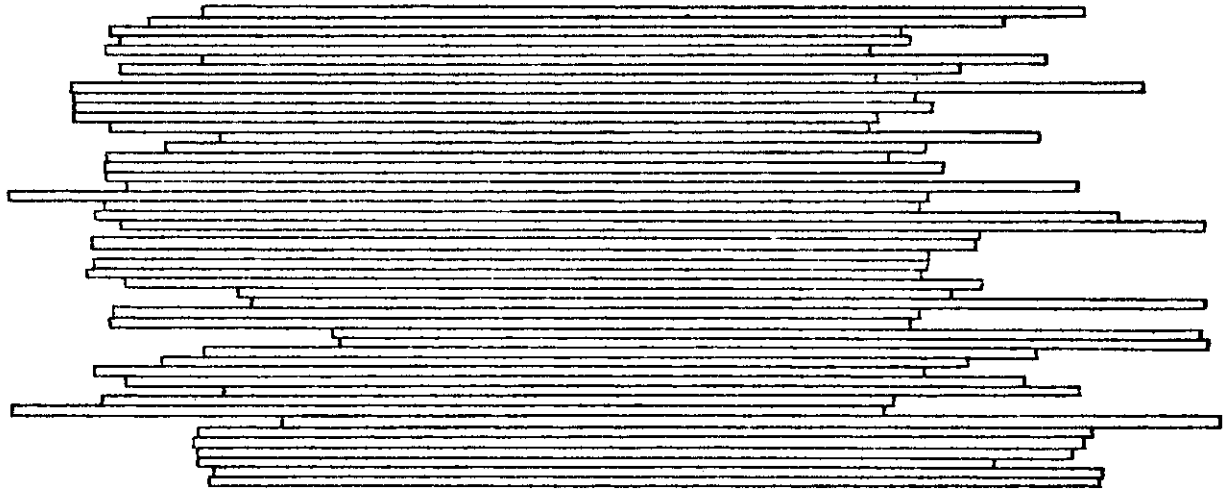


Correct method of stacking Railway sleepers. Note the open crib formation, the interspaces between the end sections of sleepers and the sloping roof for protection against the sun.



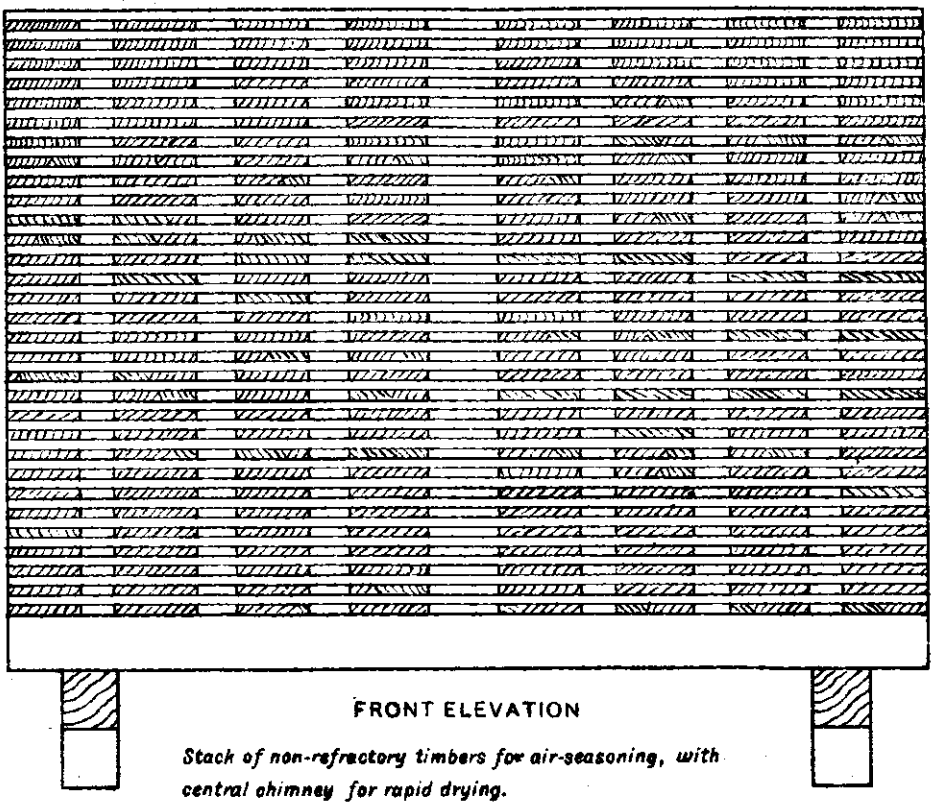
FRONT ELEVATION

Incorrect method of stacking sleepers and woods liable to decay.



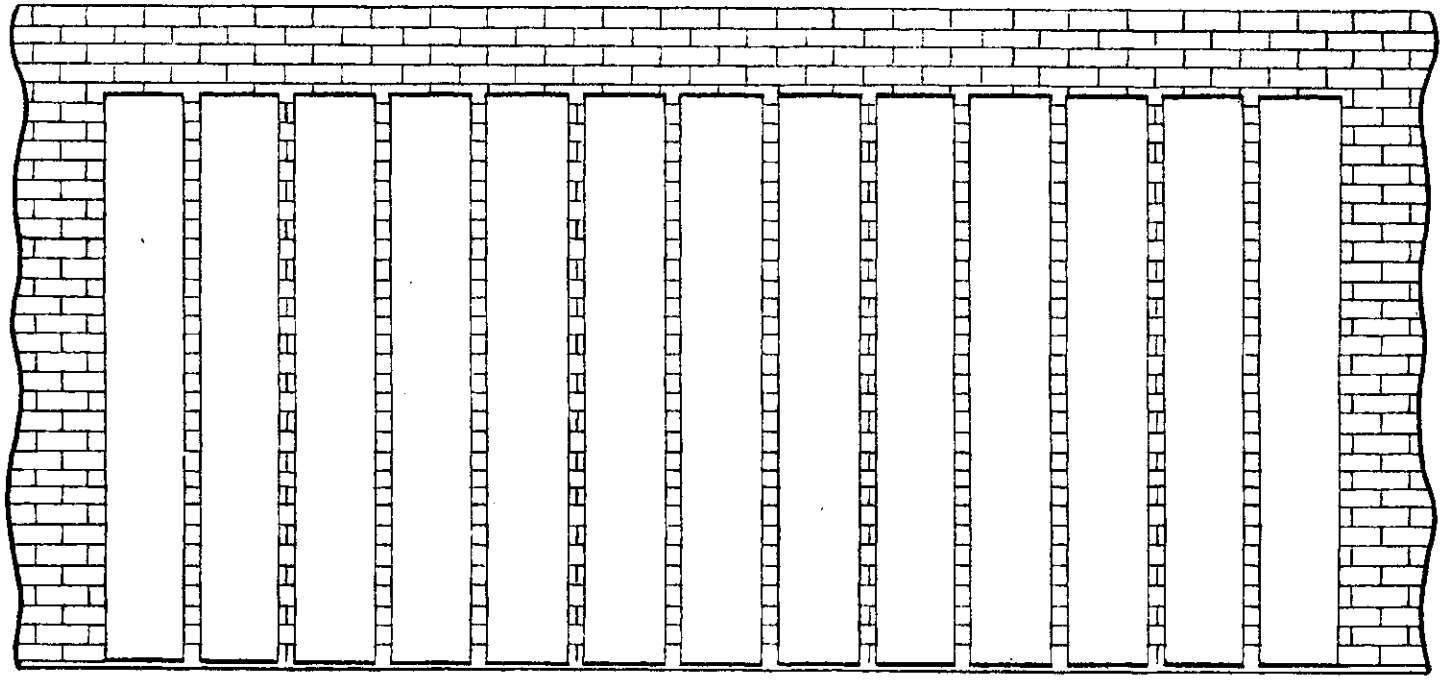
FRONT ELEVATION

A careless stacking of timbers with numerous unsupported, over-hanging ends, which are sure to lead to considerable damage due to warping and twisting of the timber.



FRONT ELEVATION

Stack of non-refractory timbers for air-seasoning, with central chimney for rapid drying.



FRONT ELEVATION

Vertical stacking of Planks against a wall for rapid drying to prevent discolouration in non-refractory species. To avoid cracking and warping of the material, the Planks should be turned frequently so as to expose alternate sides to the sun.

attached to them because they have been used without proper seasoning and thereby develop numerous faults. Progressive lumber men have been conscious of the importance of seasoning and in other countries timber is rarely used without undergoing this process. Up-to-date information regarding the methods of seasoning and seasoning qualities of Indian timbers is available in the "Manual on Air-seasoning of Indian Timbers" and "Notes on the Air-seasoning Characteristics of some Indian Woods" published by the Forest Research Institute, Dehra Dun. While air-seasoning is the least difficult and consists in the proper piling of timber, it is a very slow process, there is a danger of insect attack and the capital invested in the timber has to be locked up for 1 or 2 years during which the timber is getting seasoned. The same remarks apply as regards seasoning by girldling standing trees, a treatment which is adopted in the case of many species. Certain other species are seasoned by immersing them in water for prolonged periods. Modern research, however, has developed a technique of quick seasoning called kiln-seasoning whereby timber is seasoned in a seasoning chamber where certain specific temperatures and humidity conditions, different for different species can be maintained artificially. The Surma Valley Sawmills, a firm handling a considerable volume of the timber trade in the Surma Valley has realised the importance of supplying seasoned timber to the market and last year erected a kiln-seasoning plant capable of turning out 12 tons of kiln-seasoned timber daily.

While it may not be economical for the small lumber man to have kiln-seasoning plants, it behoves him in his own interests to endeavour to season timber by the slower but much more economical process of air-seasoning before he puts his timber on the market. The recently published "Notes on the Air-seasoning Characteristics of some Indian Woods" (M.A. Rahman) has the following remarks to offer in this regard :—"Air-seasoning is and will continue to be the standard practice of seasoning wood in India. There is no doubt that the climate of the country varies from place to place and is subject to wide seasonal fluctuations in temperature and humidity, which tell very heavily on wood stacked for air-seasoning in the open. Yet there are ways and means of protecting wood against adverse climatic influences and still make the best use of natural conditions of drying. Most of the well-known firms engaged in the manufacture of high-class furniture and cabinet-ware in Calcutta, Madras and Bombay, depend entirely on air-seasoning, and they experience little trouble either in seasoning their requirements of timbers or in the use of the seasoned material. In Burma, girdling forms the standard practice for the exploitation of Teak, and there is definite evidence that it is beneficial for the subsequent seasoning of wood after conversion. It is likely that this method may prove of service in the case of those refractory hard woods which are used in big sizes, either for constructional purposes or as railway sleepers and which do not really get a chance for proper seasoning before use. The girdling will reduce the moisture content of wood in the tree and may reduce cracking and splitting of wood subsequently in use..... On the question of seasoning in the form of log versus green conversion, our opinion is not so definite against log seasoning as before. There are indications that if the logs are stored in the forest protected against rapid drying for a year or so before conversion, although the moisture content of wood may not change appreciably, the stresses in the wood may disappear, which will lead to much less cracking of the sawn material. Our recent studies have, however, brought out one point clearly, namely that woods which are liable to heavy damage due to surface cracking, warping, twisting and collapse, give better results by seasoning in the form of thick scantlings and subsequent conversion of the seasoned material into thinner sizes.".

The methods of stacking converted material for seasoning are described fully in the Manual and illustrated anon diagrammatically. "All Indian hardwoods with very few exceptions can be seasoned within one year in the form of 1 inch thick planks. The more refractory woods have to be converted during or just after the rainy season, so as to expose the green wood to the mildest drying conditions. Less refractory woods can be sawn in the winter months or in the beginning of the dry season without any fear of excessive damage from cracking and splitting. The non-refractory woods can be sawn even at the height of the dry season. For all ordinary purposes, when the timber has passed through one dry season, it can be considered as sufficiently well seasoned. For very high class work, the material should be allowed to season for two years. This applies to one inch thick material of highly refractory woods or two inches thick material of less refractory woods. Thicker material will require longer seasoning. During the early stages of seasoning, surface cracks open out which close up as the seasoning nears completion. In many cases it has been found that in the fully seasoned material these cracks which appear as fine hair cracks run to a depth of one inch or more. The closing up of the cracks is an indication that the seasoning process is approaching completion.

The biggest source of trouble in seasoning is the presence of initial shakes in a piece of wood. In most species these shakes tend to open out causing an increase of splits, and sometimes also warping, twisting and collapse of the wood around the shakes. As far as possible, a log should be converted in such a manner that the initial shakes are cut out as they are liable to injure the sound material. The process of air seasoning is not at all difficult, and provided the ordinary precautions in the stacking of wood and protecting the stacks against rapid drying are taken, very good results can be obtained" and many so-called inferior kinds of timber will thus find a ready market. The seasoning qualities and the satisfactory methods of seasoning of the principal timbers of Assam have been dealt with under the descriptions of species appended to this note.

Diagrams illustrating methods of stacking converted timber for air-seasoning are shown in the 5 preceding pages.

(*e*) *Plywood mills.*—In addition to the above measures for the better utilisation of forest produce, an increase in the number of plywood mills in the province would be advantageous ; but for the proper functioning of such mills good stands of suitable timbers, with good facilities for extraction to the mill are necessary.

A locality which answers this description is the town of Jeypore in the Lakhimpur district, which can tap suitable timbers to the extent of about 400,000 c.ft., annually from the Tarajan Block of the Upper Dehing Reserve and the Jeypore Reserve.

CHAPTER IX

Unclassed State Forests.—The Civil authorities reported that the area of these forests was 14,557 square miles at the end of March 1939. Except for a small proportion of these forests which contains some fine stands of *Sal* and other useful timber trees, the rest is composed principally of land with sporadic trees of useful timber species. From the administrative point of view the main difference between Reserve Forests and Unclassed State Forests, is that in the latter everything is permitted unless expressly prohibited whereas in the former nothing is permitted for the public unless specifically provided. In view of the large areas occupied by these forests and the limited staff at the disposal of the Department, it must be apparent that prevention and detection of the acts prohibited in these areas can never be efficient and hence that it must be only a question of time before these

forests cease to exist as such. As Assam has only 9·7 per cent. of its total area constituted as Reserve Forest as against more than treble this percentage in more advanced countries with a proper forest sense, the gradual extinction of these forests cannot but be a grievous wrong done to the future prosperity of the province.

The main factors contributing to gradual disforestation are—

(1) Indiscriminate jhuming ;
(2) Grazing controlled only as regards realisation of grazing fees ;
(3) Indiscriminate cutting of house-hold requirements by settlement-holders free of charge ; and
(4) Squatting.

It is proposed to deal with each of these evils seriatim and to suggest measures of control—

(1) *Jhuming.*—This is an agricultural practice universal among the hill tribes of the province.

It consists of the cutting out of all forest growth generally in the best, coolest and most fertile areas on hill slopes and ridges, setting fire to it, then rising crops in the area for one to two years, after which the area is abandoned in favour of fresh areas. With the increase of population and diminishing soil fertility, larger areas per annum are being brought under this pernicious system of cultivation with the result that larger and larger areas are being rendered more and more infertile.

The principal evils of this type of *jhuming* are (1) loss of soil fertility through the exposure of the current year's and older *jhums*—which also get burnt at the time of the burning of the current year's jhums—and soil loss by erosion particularly during the early monsoon showers. It must be noticed that it is the best, humus-bearing, well-aerated soil subject to the action of nitrifying bacteria and useful protozoal agencies that is thus being washed out from the hills to the ultimate benefit of the cultivators of Bengal. This annual loss of the best layers of soil is resulting in increasing the infertility of the hill soils, endangering the future agricultural economy of the hill-tribes ; (2) continued erosion of this sort leads to the washing down of larger particles of sand of the soil and sub-soil with the result that rivers get silted up, causing floods, damage to crops, roads, bridges, railways, etc., in the plains, and consequently untold and unnecessary suffering ; (3) while there is thus a surfeit of water over short periods in flood time, the water-supply in the summer months is endangered by the absence of tree crop cover which controls the run-off of water from the hill areas. The canopies of trees prevent rain reaching the ground with force and permits of slow dripping down of rain water to the forest floor.

The litter of leaves and humus provided by the trees forms a mat through which water percolates very slowly. Similarly the minute root lets of trees enmesh water and give it up only gradually. The tree canopy keeps the forest floor cool and thus capable of conserving moisture which it gives up only gradually. Thus the moisture conserved by forests at the headwaters of important streams is given up gradually during the summer months to these streams, thus maintaining the water-supply for the plains. It will, therefore, be apparent that jhuming especially in the headwater regions of important streams is greatly inimical to the present cultivators of the plains.

The Department has proposed remedial measures but so far little has been done as the measures appear harsh and because enforcement of their adoption requires close attention and sanctions. These measures are (1)

reservation of catchment areas and steep slopes so that fire-protection or forced early burning may be introduced in them to conserve moisture and enable a scheme of forest management to be adopted for their maintenance under tree crops in perpetuity. In the Garo Hills the adoption of these measures are bound up with the question of Nokma's rights. Since these catchment areas are never of large extent, it cannot be argued that this will involve a serious curtailment of the land available for *jhuming*. Hutton in his Census Report for India mentions in connection with the population of the hill areas of Assam that the density of population is 39 per square mile. Estimating that a 3rd of this 39 consist of adult males requiring *jhuming* land, each man has got on an average 50 acres of *jhuming* land ; therefore small inroads into the total area of the Unclassed State Forests for constitution of Reserves cannot be considered as harsh measures from the point of view of curtailment of land available for *jhuming*.

(*b*) *Limitation of the* jhum *fire to the current year's area.*—The importance of maintenance of a tree crop has been stated before. Such a state of affairs cannot be maintained for long with unrestricted fires. It will be difficult to enforce this salutary measure but insistence can be placed on each *jhummier* cutting a fire line round his *jhum* before burning it and the evil effects of annual fires on soil fertility can be pointed to tribesmen by propaganda ;

(*c*) *Introduction of terraces for wet cultivation.*—Terracing does not permit of rapid run off of water with fertile humus in the rains. All fertile silt will get deposited in the successive terraces thus conserving soil fertility. The terraces also permit of the rain water soaking to the sub-soil ; small bunds can be created between terraces to further slacken the pace of the on-rush of water down the slopes.

(*d*) *Leaving belts of permanent tree forests between terraced taungyas.*—These forests will permit of collection of leaves and humus for manuring in the terraces, act as wind-breaks and provide grazing, firewood and other forest produce for the *jhuwing* community.

(*e*) *Sowing up the area with quick-growing species when the jhums are abandoned.*—This will be particularly important if terracing is not adopted. With increasing population the jhuming cycle will have to be reduced so that the same lands will have to be taken up for jhuming at shorter intervals. Unless quick-growing tree species are permitted to grow by broad-casting their seeds, these abandoned jhums will not have sufficient humus and moisture to provide good crops in the second and subsequent rotations.

TREES SUITABLE FOR GROWING IN JHUMS

The following are quick-growing species and to these may be added any of the slower-growing species found locally :—

Botanical name	Tribal names
Macaranga denticulata ...	... Jagura, Beng ; Gulte, Sylh ; Dienglakharong, Kh ; Mollata, Manip ;
Macaranga indica ...	... Bol-thothru, Garo ; Jaglo, Ass ; Lakoi, Manip ; Jhakura, Cach ; Ding-lakhar, Kh ;

Botanical names	Tribal names
Trema orientalis	Phakram, Garo ; Gunali, Sylh ; Sovai, Ass ; Rampak-arong, Mik ; Jhupon, Ass ; Dienglangta, Kh.
Anthocephalus cadamba	Roghu, Ass ; Loghu-arong, Mik ; Banta lang, Lush ; Kodom, Sylh and Cach ; Naranpadum, Kuki ; Diengsohlang-pathi, Kh.
Trewia nudiflora	Bhel-kol, Ass ; Phel-kol, Ass ; Mera, Sylh ; Bhuara, Cach ; Chaliang, Garo ; Diengsoh-lyndot, Kh.
Columbia floribunda	Arlak-pi, Mik ; Khasre, Nep ; Thaltre, Lush ; Antha-thing, Kuki ; Larubanda, Ass.
Melia azedarach	Abari-asing, Miri and Abor ; Bokain, Hind ; Ghoranim, Mahanim, Beng ; and Ass ; Dieng, jah-rasang, Kh.
Sterculia villosa	Udal, Odal, Ass ; Heppuk-bang, Naga ; Udal, Sylh ; Cach ; Umak, Garo ; Ruija, Kuki ; Sergok-asing, Miri and Abor.
Cedrela toona	Poma, Ass ; Tun, Beng ; Suria-Poma, Sylh ; Khat-mai, Cach ; Poma-arong Mik ; Diengtulleny, Kh ; Jati-poma, Ass.
Grewia laevigata	Rampak-arong, Mik ; Ganghthi, Sylh ; Bol-mengu, Garo ; Thing-hap-khir, Kuki ; Dieng-tiew-ser, Kh ; Mithang-samjia, Cach.
Erythrina stricta	Madar or Mandar, Beng ; and Ass ; Tagat-asing, Miri and Abor ; Mander-phang, Kach ; Phartu, Lush ; Diengsoh-dkar, Kh ; Mandal, Garo.
Erythrina ovalifolia	Hari-kekra, Beng.
Alnus nepalensis	Dieng-soh-risang, Kh ; Littisii, Sema.
Callicarpa arborea	Mai-phai, Kuki ; Dieng-lakhit, Kh ; Bun-mola, Ass ; Arhi-arong, Mik ; Phul-uja, Cach ; Mach, Kaita, Ass.
Rhus semialata	Naga-tanga, Ass ; Sohma, Kh ; Khit-ma, Garo ; Gimbao, Kach; Bhakhim-lo, Nep ; Dieng-sohma, synteng ; Dieng-sohsma, Kh.
Helicia erratica	Diengsoh-syrtet, Kh ; Diengsoh-salyrtet Syn.
Lindera caudata	Diehg-tharthia, Kh ; Dieng-Salu, Syn ;
Maesa indica	Awua-pat, Machh-pora, Ass ; Sirkhi, Mech ; Samanakhatok, Garo ; Kisutanop, Miri ; Dieng-soh-jala-tyrkai, Kh.
Evodia fraxinifolia	Dieng-sngi-iat, Dieng-Bora-pram, Kh ; Dieng-subu-klong, Synt.

GRAZING SETTLEMENT AND SQUATTING

So far the problem of planned utilisation of the Unclassed State Forests from the point of view of jhuming and conservation of soil fertility has been considered.

In the plains areas, the methods of destruction of Unclassed State Forests are by (*i*) grazing, (*ii*) settlement and (*iii*) squatting.

Here planned utilisation will require investigation of (1) the possibility of planned opening up for permanent cultivation of suitable parts of these forests and (2) programmed maintenance of other Unclassed State Forests. In general, the Unclassed State Forests are comprised of high-lying land with scattered valuable trees, unsuitable for rice or jute cultivation. There are small areas in the neighbourhood of villages of high land where such crops as mustard and pulses can be grown ; but in actual practice even when small areas of such land are taken up for cultivation, cultivation is generally given up after a year or two on account of exhaustion of the soil. Meanwhile useful timber trees which had taken well-nigh a hundred years to grow would have been destroyed and revenue from them completely lost. Thus by unplanned settlement for short periods giving meagre land revenue to Government, timber revenue in large quantities is lost by destruction of forests. This can be remedied only by requiring that all settlements should be effected only after prior inspection on application, due notice to the Forest Department so that the latter can arrange for disposal of the standing tree crop and on guaranteed payment of land revenue for 10 years or a similar suitable period.

The destruction of Unclassed State Forests is resulting in some districts especially in North Kamrup and in the colonisation areas of Mangaldai, Nowgong, etc., in an acute shortage of firewood. In every colonisation area, portions of the Unclassed State Forests require constitution as reserves from which a supply of fire-wood and small house-building and bridging material can be ensured for the well-being of the settlers.

With the salutory prominence now being given to cottage industries, such as sugar-making, wood-carving, cottage match factories, hand-made paper-making, all requiring a steady supply of timber for implements and raw material from the neighbourhood, the necessity for small forest reserves in the neighbourhood of the smaller towns and villages is apparent.

Similarly grazing reserves require constitution out of areas carved out of the Unclassed State Forests and the rotational system of grazing requires introduction. The present grazing reserves are such only in name. These grazing reserves were originally carved out of savannah land in the Unclassed State Forests ; with the grazing of domestic animals came a change in the vegetational constitution of these forests for the worse ; the coarse grasses of the savannah were reduced to a close short turf which does not produce the most nutritious feeding for cattle. Dr. Bor, the well-known Assam Forester and authority on grasses remarks as follows :—" Generally speaking, when an area is laid bare it is the more highly developed grasses which colonise it and not the more primitive. This has an important bearing when considering the grazing grounds of Assam, because the most palatable grasses of all are the soft-stemmed, broad-leaved species of the *Pooidae* and *Paniceae*. They cannot, however, compete with Andropogoneae unless in their own special habitats which are the forest, forest margins and moister parts of the province."

" The Andropogonous grasses of the savannah " (Grazing Reserve) " are coarse fibrous grasses which are not relished by cattle, but cattle wilsl eat them in default of anything else. The young leaves and stems which are sent up by the underground rhizomes at the close of the annual fires are acceptable and greedily eaten by cattle ". But after this good morsel, for the rest of the year the grazing Reserves yield but little palatable fodder. Continued grazing in such areas destroys all palatable grasses by selective grazing till ultimately unpalatable stunted grasses and noxious shrubs occupy the ground providing no pasture from the land.

The great utility of maintaining Unclassed State Forests under tree crop from the point of view of providing pasture for cattle and hence the imperative necessity for maintaining them, as well as the urgent need for introduction of rotational grazing in such will thus be apparent. If these measures are to be adopted to maintain these forests, there must be a controlling authority and sanctions. Hence such Reserves maintained primarily for grazing should be under the control of the Department and the expenditure to be incurred in forced early burning or fire-protection to maintain the luscious grasses, shrubs, etc., climber-cutting, thinning, etc., may be met by levying a cess on extra bulls above a specified number required for draught purposes and on cows above a specified number maintained uselessly by villagers at present.

If these measures in regard to the present Unclassed State Forests are adopted a great fillip will be given to agricultural and cottage industries development in the province, for it has been well said by the Royal Agricultural Commission that in the main forestry should be the hand-maiden of agriculture—especially in a land where 90 per cent. of the population are agriculturists. Without programmed forestry agriculture cannot flourish.

APPENDIX

1. *Acacia catechu*, Willd (Khoir or Khoira).

Habitat.—A gregarious riverain species in the Goalpara, Kamrup and Darrang Divisions.

Supplies.—About 4,000 trees above 3′ in girth may be annually available from all the above Divisions together.

Qualities of the wood.—Sapwood white to yellowish-white ; heartwood red or dark red turning brownish-red with age ; somewhat lustrous; smooth feel ; heavy to very heavy ; straight grained ; medium to coarse-textured ; weight 63 lbs. per cubic foot ; extremely strong and very hard timber ; seasons slowly ; should be converted when green ; seasoned logs difficult to convert; end-splits occur if seasoned in thick planks ; seasons well by artificial means ; turns nearly black with age ; one of the most durable of Indian timbers ; attacked neither by white ants nor by toredo ; lasts longer in contact with ground than Teak ; somewhat difficult to saw and machine ; difficult to chip by machinery ; good for turnery work.

Uses.—A very valuable timber ; produces excellent and lasting house-posts ; can be made into rice pestles, sugarcane-crushers, stocks and felloes of wheels and carts, tents-pegs, etc ; primary use is for cutch and katha manufacture.

2. *Acrocarpus fraxinifolius*, Wight et Hon. (Bol-mangal, Silcho).

Habitat.—A tall deciduous tree of scattered occurrence in Goalpara, Nowgong, Cachar, Garo Hills and Khasi Hills.

Supplies.—Only very small quantities are available from Nowgong and the Garo Hills.

Qualities of the wood.—Sapwood white ; heartwood light red ; rather lustrous ; working smooth ; moderately heavy ; somewhat interlocked or wavy-grained ; extremely coarse-textured ; weight 43 lbs. per cubic foot ; mod rately hard and strong, about equal to Chukrasia, seasons easily and with few defects ; green conversion best ; if left in the log splits badly ; kiln-seasoned easily ; fairly durable though attacked by insects if left for one year or more in the log; has never been antiseptically treated ; easy to saw ; some amount of resin clogging occurs in green logs ; works and machines with ease ; finishes well ; takes a high lustrous polish.

Uses.—Primarily used as a boxwood ; also for ceiling boards, planking, furniture, etc., should yield a fine ply-wood.

3. *Adina cordifolia*, Hooker (Haldu, Tarakchapa, Laopatia).

Habitat.—A large, deciduous tree common throughout the province except Upper Assam.

Supplies.—About 100 tons may be available annually from Kamrup, Garo Hills, Cachar and Nowgong.

Qualities of the wood.—Sapwood yellowish white ; rather thick, grading gradually into the heartwood ; heartwood citron yellow when first exposed turning pale reddish brown with age ; quite lustrous with fairly smooth feel ; light to moderately heavy ; fairly straight-grained or somewhat spiral or interlocked grained in broad bands ; fine and even textured ; 40 lbs. per cubic foot; strong and hard ; slightly less strong than Teak ; green conversion and seasoning after 12 months satisfactory ; liable to insect-attack unless barked ; air seasons and kiln seasons well ; susceptible to climatic variations when made up into furniture ; moderately durable in exposed situations

and durable under cover ; not treated artificially ; saws with ease ; one of the nicest Indian woods either to work by hand or by machine and turns well requiring little hand finish ; polishes well ; but to retain its colour a white polish should be used.

Uses.—Used for a variety of purposes ; planking, dugouts, fresco work, drums, shingles ; one of the best turnery woods in India and commonly used for toys, rulers, penholders, jute bobbins, etc. ; found suitable for brush-backs and cement barrels.

4. *Albizzia lebbek.* Benth.

Not very common.

5. *Albizzia odoratissima,* Benth (Hiharu).

Habitat.—Plains of Assam from Goalpara and Sylhet to Darrang ascending to 3,000 feet in the Khasi Hills.

Supplies.—About 200 tons from the province annually, mainly from Nowgong, Darrang and Cachar.

Qualities of the wood.—Sapwood wide, white ; heartwood brown to dark brown with lighter and darker streaks ; lustrous when first exposed ; working to a smooth shining finish ; moderately heavy to heavy ; shallowly and broadly interlocked-grained ; coarse-textured ; weight 43 lbs. per cubic foot ; strong elastic, hard, not unlike Teak in these respects ; seasoning in the long requires about two years ; hence green conversion and seasoning in the plank is best ; sleepers do not split when heartwood is boxed ; sawn into thin planks, twists and warps ; in the log, durable ; fairly resistant to white ant attack ; difficult to treat antiseptically ; not easy to saw and difficult to work and to chip ; hard on saws and tools when dry ; works to a fine smooth, shining surface ; takes a good wax polish.

Uses.—Valuable constructional and cabinet wood ; useful for decorative and panelling work ; reported to be a first class timber for propeller blades of aeroplanes by the R. A. F ; suitable for cement barrels.

6. *Albizzia procera,* Benth (Koroi).

Habitat.—Large tree of riverain and lowland savannah forests all over the province.

Supplies.—Small quantities are available, mainly from Kamrup, Haltugaon, Darrang and Nowgong Divisions.

Qualities of the wood.—Sapwood white, subject to sap-stain, perishable ; heartwood brown with lighter and darker bands ; lustrous ; works to a smooth, shiny surface ; light to moderately heavy ; straight or broadly interlock-grained ; very coarse and even-textured ; weight 40 lbs. per cubic foot ; strong, elastic, tough and hard, stronger than Burma Teak ; conversion from green logs gave best results ; girdling gave slightly poorer results ; if left in the log, heart shake develops ; kiln-seasoning satisfactory ; heartwood durable in exposed positions ; very durable under cover ; untreated sleepers have a life of about ten years ; not easy to treat antiseptically ; somewhat difficult to saw by hand ; stands up fairly well to high-speed machinery ; requires careful filling before polishing.

Uses.—A valuable timber, suitable for constructional purposes, carriage and cart building, furniture making, house-posts, etc. Used for carving in Assam.

7. *Alseodaphne owdenii* (Maricha sundi).

Habitat.—An evergreen tree found commonly in the Cachar and Sylhet Divisions.

Supplies.—Fifty tons annually.

Uses.—A commonly used general utility timber of the same class as the Magnoliaceae in the Surma Valley.

8. *Alstonia scholaris*, B. Bouv. (Chatiyan).

Habitat.—A large-sized tree with a 40′ straight, but often buttressed stem ; occurs scattered all over Assam.

Supplies.—Some 50—100 tons may be available from the province.

Qualities of the wood.—White when first exposed, ageing to yellowish white or pale brown ; frequently discoloured by fungal stain ; heartwood not distinct ; quite lustrous ; working smooth without characteristic odour ; fine and even textured ; 30 lbs. per cubic foot ; principal defects in air seasoning susceptibility to stain, decay and insect-attack ; other defects negligible ; green conversion and stacking gives the best results ; not durable but will last as much as Bombax ; easy to saw and work and finishes to a dull moderately smooth surface ; peels easily on a rotary cutter and can be made up into a fair three-ply board.

Uses.—Not in use in Assam ; can be used for packing cases and tea boxes; tried for match making and passed as a 2nd class timber for the purpose.

9. *Altingia excelsa*, Noronha (Jutuli).

Habitat.—A very large tree, up to 80′ cylindrical bole, in evergreen forests of Lakhimpur, Sibsagar and Sadiya Divisions and is almost gregarious in Charduar and portions of Balipara and Biswanath Reserves in Darrang Division.

Supplies.—Fairly large quantities are available in the tracts mentioned above.

Qualities of the wood.—Flesh-coloured to red, reddish-brown or brown ; heartwood not distinct from sapwood ; dull to somewhat lustrous especially on the radial surface ; smooth feel ; sour odour ; moderately heavy ; moderately hard to hard ; irregularly and somewhat interlocked grained ; fine and even textured ; weight 48 lbs. per c.ft.; air seasoned timber hard to very hard ; not far short of Teak in transverse strength ; difficult to season ; green conversion and stacking in close piles under cover is best for seasoning; surface cracking characteristic ; requires atleast 2 years for complete seasoning in thickness up to 2 inches; the timber should be stacked very carefully, as any unsupported or badly supported ends are liable to get crooked and twisted. It requires slow seasoning and maximum protection against rapid drying ; moderately durable in exposed positions ; very durable under cover ; sleepers treated with creosote and earth oil were found to be sound after eight years ; considered to be one of the best sleeper woods (after treatment) from durability tests in 1915 ; easy to deal with when green ; difficult to saw when seasoned ; not suitable for high class furniture or turnery.

Uses.—Extensively used in Assam for constructional purposes ; first class sleeper after treatment.

10. *Amoora wallichii*, King (Amari and Lali).

Habitat.—Moist evergreen forests of all Divisions.

Supplies.—About 500 tons will be available from the province annually.

Qualities of the wood.—Sapwood light red, heartwood red when first exposed ; ageing to reddish brown ; dull to somewhat lustrous, light, fairly soft ; even and very straight grained ; medium textured ; weight 33 lbs. per

cubic foot ; moderately hard to hard ; seasons well and does not split converted material to be given open stacking under cover to get best results ; can stand rapid seasoning without degrade ; fairly durable and not much attacked by insects and fungi ; takes a good polish.

Uses.—Used in considerable quantities by Assam-Bengal Railway for carriage building ; also used as a constructional timber ; used for boat making, dugouts, etc ; a fine timber for furniture ; should give an ornamental ply-board.

11. *Anthocephalus cadamba*, Miq. (Kadam, Raghu).

Habitat.—A large tree with a clean straight stem of about 30′ ; found all over Assam in damp places and alongside large streams.

Supplies.—No reliable figures are available but fairly large supplies can be effected.

Qualities of the wood.—White with a faint yellow cast ; ageing to creamy white ; heartwood not distinguishable ; smooth feel ; light, straight-grained ; medium and even textured ; 34 lbs. per cubic foot ; moderately strong but relatively soft ; does not split and warp when seasoning but liable to develop stain ; best method of seasoning is conversion immediately after logging and stacking under cover ; not durable in exposed positions ; moderately so under cover ; should treat antiseptically without difficulty but not tested ; saws and works with great ease ; can be readily peeled into veneers on a rotary cutter.

Uses.—Used for cheap boarding and packing cases as also tea boxes ; yields a rather inferior splint for matches.

✓ 12. *Artocarpus chaplasha*, Forst. (Cham, Sam).

Habitat.—A large, evergreen tree with milky juice found in moist localities all over the province.

Supplies.—About 1,000 tons may be available annually from the province mainly from the Lakhimpur and Cachar Divisions.

Qualities of the wood.—Sapwood white or pale yellowish white ; heartwood yellowish brown to golden brown with lighter and darker streaks ; lustrous becoming dull with age ; smooth feel ; requires care to bring to a good surface ; straight or shallowly interlocking grained ; coarse and even textured ; 32 lbs. per cubic foot; moderately hard and strong ; liable to surface cracks, and splits and warps ; best results by girdling and further seasoning after conversion for 6 months ; air-seasoned in the form of 1½″ thick planks the timber dried without appreciable degrade ; kiln-seasoning not satisfactory because of many small surface cracks ; moderately durable when exposed and durable under cover ; average life of untreated sleepers 7 years ; resists insect and white ant attack fairly well ; saws easily and works well but care required to bring to a good surface ; polishes well but requires lots of filling ; peels well on a rotary veneer cutter and gives a strong 3 ply-board.

Uses.—Extensively used for canoes, boats, dugouts, house-building, furniture, wheelwright's work and carriage bodies. A sound timber for construction and veneers ; actually gone out of use because of warping and splitting to be remedied by proper seasoning.

13. *Artocarpus integrifolia*, Linn. (Kathal).

Habitat.—A cultivated tree all over Assam, sometimes grown in plantations and taungyas ; trees with large crown and short bole.

Supplies.—Moderate quantities available from household land and the main demand is in the Surma Valley.

Qualities of the wood.—A yellow coloured fine lustrous timber, takes a fine polish.

Uses.—Eminently suitable for furniture.

14. *Artocarpus lakoocha*, Roxb.

Less common ; uses can be almost the same as A. chaplasha ; not much used now. One inch thick planks seasoned fully in one dry weather without any appreciable degrade ; somewhat liable to mould and discolouration, if the initial drying is not rapid.

15. *Betula alnoides*, Don.

Habitat.—A moderate sized to large evergreen tree of purely local occurrence in the Khasi Hills between 3,000'—5,000'.

Supplies.—No sustained yield is possible.

Qualities of the wood.—Sapwood white ; heartwood light greyish red to pinkish grey ageing to grey or greyish brown ; lustrous when first exposed but dullens with age ; works to a smooth surface under tools ; light to moderately heavy ; straight grained, medium, fine and even textured; 41 lbs. per cubic foot ; no records available regarding seasoning.

Uses.—Put to little use ; a few trees have been used for furniture.

16. *Bischofia javanica*, Blume. (Uriam).

Habitat.—A large evergreen tree with a short bole common in swampy localities and near water-courses.

Supplies.—About 1,000 tons may be annually available from the province mainly from the Lakhimpur Division.

Qualities of the wood.—Sapwood cream coloured to reddish brown ; narrow, grading into the heartwood ; heartwood red to dark reddish brown ; dull with rough feel ; with a strong scent of vinegar ; moderately heavy ; straight or somewhat irregularly interlocked grained; fairly coarse and even textured; 47 lbs. per cubic foot ; seasons fairly well but liable to warp ; amenable to treatment ; kiln-seasoning satisfactory ; moderately durable ; lasts 5 or 6 years in the untreated state ; lasts extremely well under water being nearly imperishable ; saws without difficulty and works to a smooth finish.

Uses.—Chiefly used for construction as beams and as posts for which it is specially suitable ; used for dugouts and wheels ; to a limited extent in Assam for carving ; extensively used in the past in Assam as sleepers ; sleepers often mixed with Nahor sleepers and passed as such ; formerly used for tea boxes.

17. *Bombax malabaricum*, D. C. (Simul).

Habitat.—Of common occurrence all over the Assam forests.

Supplies.—Fairly large supplies are available but quantities which can be economically put on the market are limited.

Qualities of the wood.—Very light, straight-grained and coarse textured ; white or pale yellowish brown, pores very large, distant and irregularly distributed with high starch content and very subject to fungal sub-stain ; a perishable timber ; 25 lbs. per cubic foot ; softwood of the plank and box-wood class ; timber should be left in the log unless completely submerged as it rapidly becomes discoloured and attacked by insects ; for most purposes for which this wood is used, a short period of air-seasoning is quite sufficient but if well-dried material is required, stacking for one dry weather is essential ; immersed in water extremely durable ; hence useful for well-curbs ; easily sawn.

Uses.—Packing cases ; also commonly used as boarding for ceilings in dry localities ; used for match making yielding good box but indifferent splints.

18. *Bridelia retusa*, Willd, (Kohir).

Habitat.—A middle sized tree found in mixed deciduous and *sal* forests in Goalpara, Kamrup, Garo Hills and Darrang.

Supplies.—About 100 tons may be annually available from all over the province, chiefly from North Kamrup and Darrang.

Qualities of the wood.—Sapwood greyish white to grey, not sharply demarcated from the heartwood ; heartwood red to olive brown sometimes with darker streaks due to interlocked grain ; works to a smooth surface ; moderately heavy ; medium or fairly even textured ; 47 lbs. per cubic foot ; moderately hard to hard ; seasons without serious defects ; logs should be be converted as soon after felling as possible and stacked under cover ; durable, especially so contact with water ; saws and machines well and works to a nice smooth surface ; easily worked with hand tools.

Uses.—In fair demand for house building, especially for posts, carts, yokes, cart-shafts and agricultural implements.

19. *Callicarpa arborea*, Roxb. (Khoja).

Habitat.—A small tree very common in the mixed deciduous forests and *sal* forests of the province ; generally crooked.

Supplies.—About 100 tons of small sizes may be annually available from the province.

Qualities of the wood.—Pale brownish white ageing to light greyish brown ; interlocked grained ; medium and even textured ; perishable and liable to insect attack ; easy to saw and work but does not finish to a good surface.

Uses.—Has been tested at Dhubri and found suitable for match-splints ; might produce a rough boarding.

20. *Cassia fistula*, Linn. (Sonaru, Bandalot),

Habitat.—Mixed decidous forests all over the province.

Supplies.—The main supplies come from Nowgong. Fair supply only.

Qualities of the wood.—Sapwood white ; heartwood greyish or yellowish red to brick-red ; often with darker streaks : ageing to dark purplish brown ; works to a smooth finish; heavy to very heavy ; straight grained or nearly so ; medium coarse-textured; weight 50 lbs. per cubic foot; difficult to season; liable to surface cracking, cupping and splitting ; girdling gives best results ; water-seasoning worst ; green conversion fairly good with less damage by insects compared to girdling ; heart-wood very durable both in exposed positions and under cover ; sapwood not liable to attack by fungi but very liable to attack by borers ; this might be overcome by antiseptic treatment ; liable to splinter under tools ; rather difficult to saw when green ; this does not arise when seasoned ; takes good and lasting polish.

Uses.—A good durable timber for house posts, bridge posts, rice pounds, wheels, stocks and shafts of carts and plough handles, pick-axe and axe handles and other articles where strength and toughness are primary considerations.

21. *Castanopsis hystrix*, A.D.C. (Hingori).

Habitat.—A middle-sized tree affecting stream banks and moist localities all over the province.

Supplies.—At present not worked but large quantities are available mainly from the Lakhimpur Division.

Qualities of the wood.—White when first exposed, turning to grey or greyish brown with age; sapwood not distinguishable from the heartwood ; rough feel; light to moderately heavy ; more or less irregularly interlocked grained ; medium and uneven textured ; 42 lbs. per cubic foot ; moderately hard ; air seasons easily and rapidly in scantlings and often used in the green state ; sleepers containing the core of the tree liable to end splitting; surface cracking negligible ; very durable in exposed positions ; untreated sleepers have a life of 4 years ; treats without difficulty ; easy to saw and work and finishes to a good surface.

Uses.—Not used in Assam under its name but often mixed up with better timbers ; not a bad constructional timber of the 2nd class and suitable for sleepers after treatment.

22. *Cedrela toona*, Roxb. (Poma, Toon).

Habitat.—Sporadically occurring all over Assam forests.

Supplies.—No reliable data available but probably about 200 tons annually may be available from the province.

Qualities of the wood.—Sapwood pinkish or greyish white ; rather sharply, defined; heartwood light brick red when first exposed, ageing to a rich reddish brown ; somewhat lustrous, fragrant with cedary smell ; light, straight grained ; moderately close and somewhat uneven-taxtured ; ring porous ; weight 37 lbs. per cubic foot ; moderately hard; seasons best by girdling trees for one year, air-seasoning for 6 to 12 months after conversion ; proper stacking required otherwise warping takes place ; contracts while seasoning more than any other timber known ; even when thoroughly kiln-seasoned, expansion and contraction with variations of humidity take place ; kiln-seasoning easy ; durable under cover, moderately so in exposed positions ; borers readily attack the logs if left unbarked ; liable to white ant attack ; easily treated with antiseptics; saws and works easily; takes a fine polish.

Uses.—Primarily used for furniture and indoor constructional work ; carriage building, tea boxes and cigar boxes ; moderately ornamental timber for panelling but liable to expansion and contraction.

23. *Chukrasia tabularis*, Adv. Jus. (Boga poma).

Habitat.—Of sporadic occurrence all over Assam forests.

Supplies.—About 200 tons may be available from the province annually; main supplies will come from Cachar.

Qualities of the wood.—Sapwood pale yellowish or brownish white grading into the heartwood ; heartwood yellowish red to red ageing to yellowish brown or reddish brown ; lustrous with a beautiful satiny sheen ; light to moderately heavy ; uneven grained, even and medium fine-textured ; timber from trees in Upper Assam lacking in figures ; weight 40 lbs. per cubic foot ; fairly strong, moderately hard ; more so than Toon timber ; seasons well, even in large sections ; develops fine hair surface cracks if timber not thoroughly seasoned ; logs should be converted green and stacked under cover in open places; durable under cover, not in the open; liable to white ant attack ; wood saws and machines easily ; nice wood to work with hand tools ; finishes to a good surface ; takes a high and lasting polish ; boards show good figures.

Uses.—General construction, furniture, dugouts and carving ; good timber of furniture class; Government House, Shillong has some veneer panelling which is extremely pretty.

24. *Cinnamomum cecidodaphne*, Meissn. (Gonseroi).

Habitat.—A large evergreen tree found sporadically all over Assam.

Supplies.—About 200 tons may be annually available from all over the province.

Qualities of the wood.—Yellowish or olive green grading to light brown towards the centre of the tree, often with lighter or darker bands; interlocked grained; lustrous ; working smooth ; highly scented when fresh with a strong camphor odour ; medium and fairly even textured ; 30 lbs. per cubic foot ; moderately hard and strong ; seasons well ; durable in exposed positions and in contact with water ; largely immune to insect and white ant attack ; requires no antiseptic treatment; easy to saw and work finishing to a fine smooth surface takes a high and lasting polish.

Uses.—A valuable timber ; a good furniture wood ; specially prized for cup-boards and boxes as the odour keeps away moths and insects ; nearly equal to *sal* for dugouts ; the Assam-Bengal Railway uses it for carriage construction.

25. *Cinnamomum glanduliferum*, Meissn.

Habitat.—A large evergreen tree but even more sporadic in its occurrence than C. cecidodaphne, has the same distribution as the latter.

For commercial purposes it is exploited under the same name as Gonseroi.

26. *Cynometra polyandra*, Roxb. (Ping).

Habitat.—A large straight tree, 30—35 ft. bole ; of sporadic occurrence in the Khasi Hills and more plentiful in Cachar.

Supplies.—Plentiful up the Barak river in Cachar; a supply of about 600 tons annually available from this Division.

Qualities of the wood.—Light red to claret-red, often with deeper lines of the same colour ; fading to pinkish grey ; somewhat lustrous ; working to a beautiful smooth surface ; heavy ; straight or somewhat curly grained ; medium textured ; weight 56 lbs. per cubic foot ; a very strong and hard timber with 1·32 times the transverse strength of Teak and three times as hard in the end section; a difficult wood to season in the log owing to end-splits; prompt green conversion and stacking in open piles best; not very durable in an untreated state ; not very easy to saw by hand ; finishes to a fine surface ; easily peeled on a rotary lathe.

Uses.—Not much in demand ; capable of producing sleepers or ply-boards with good figure ; at present exclusively used for tool-handles ; this is the best wood for this purpose in India.

26. *Dalbergia sissoo*, Roxb. (Sissoo).

Habitat.—A tree occurring more or less gregariously in riverain forests in Goalpara, Kamrup and Darrang and one patch in Nowgong.

Supplies.—About 100 tons can be supplied annually from the province mainly from Goalpara and Kamrup. Very large sized trees are completely absent.

Qualities of the wood.—Sapwood white to pale brownish white ; heart-wood golden-brown to dark brown with deep brown streaks, soon becoming dull ; works smooth with care; moderately heavy to heavy ; interlocked grained in narrow tangential lines; medium coarse-textured; weight 50-53 lbs. per cubic foot; a strong and elastic timber; harder than Teak. This wood can stand very rapid drying without suffering any appreciable damage from cracking, splitting and other defects. It is truly a remarkable wood in this respect ; girdling recommended for seasoning for 18 months followed by

conversion and seasoning the sawn stock for 12—18 months more ; kil seasoning enhances the value of the timber by darkening the colour ; hea wood rarely attacked by borers ; one of the least susceptible Indian woo to white ant attack ; saws fairly easily ; equal to Teak ; machines wel takes a good machine finish ; easy for turning ; good and ornament veneers obtained ; takes glue well ; lends itself readily to bending even large sizes.

Uses.—In great demand in other provinces for high class furnitu making and panelling ; used in buildings as boards, scantlings, rafters a posts ; for cart and coach building as felloes, stocks, spokes, shafts, be rims, body-bottoms, and foot-boards for gun carriage wheels ; for bo building in the Ganges ; in Assam used for carving (heartwood) ; hamm handles, bentwood furniture, and wheel rims ; produces decorative a strong ply-boards ; an extremely good timber for general carpentry pu poses ; Assam Sissoo shows better figures than Jalpaiguri Sissoo.

28. *Dillenia indica,* Linn. (Otenga).

Habitat.—A large-crowned evergreen tree of relative short heigh growth, frequenting moist localities such as the banks of streams and occu ring in all the forest Divisions of the province.

Supplies.—Obtained in small quantities from all Divisions but t major source of supply is the Lakhimpur Division, from where t estimated quantity available is about 50,000 tons for about ten years.

Qualities of the timber.—Sapwood pale red ; heartwood reddish brow moderately hard and heavy ; interwoven fibres ; somewhat twisted grain and of coarse texture ; weighs about 40 lbs. per cubic foot ; very liable splitting and warping while seasoning; easy to saw and work ; if quarter-sa gives good figure.

Uses.—Untreated timber is used in small quantities for planking a rafters for internal work. Untreated sleepers have a durability of less th three years whereas treated sleepers have lasted, most of them for nine yea

29. *Dillenia pentagyna,* Roxb. (Akshi).

Habitat.—A typical tree of burnt forests, fair-sized and about 60' height. Found in *Sal,* mixed deciduous and savannah forests all over t province.

Supplies.—About 50,000 tons can be annually supplied from the p vince. The best sources of supply are the Goalpara, Kamrup, Nowgo and Darrang Divisions.

Qualities of timber.—Sapwood pale red ; heartwood reddish gre moderately hard and heavy ; interwoven fibres ; somewhat twisted grain and of coarse texture ; very liable to warping and twisting because of ra seasoning ; 40 lbs. per cubic foot; easy to saw when green but difficult wh dry.

Uses.—Used to a very small extent under cover for house-posts, raft and planking. If quarter-sawn gives good figured panelling.

30. *Dipterocarpus macrocarpus* (Hollong).

Habitat.—An evergreen tree, growing to huge dimensions ; clean bol large girth and a comparatively small crown for its size ; common in t evergreen forests of the Lakhimpur, Sibsagar and Sadiya Divisions.

Supplies.—About 20,000 tons are expected to be annually available fr the above three Divisions.

Qualities of the wood.—Sapwood greyish or brownish white ; heartwood light-red to reddish brown, moderately heavy ; somewhat interlocked grain; even and coarse textured ; weight 45 lbs. per cubic foot ; the timber is as strong and elastic as Teak; does not warp or split excessively ; seasons slowly; not durable when placed in exposed situations but lasts well under cover ; easy to treat with creosote and creosoted sleepers have a life of at least nine years; saws with great ease, machines well and takes a fair polish.

Uses.—Used locally as beams, scantlings, planks, boards and plywood, etc. for general internal construction work ; treated sleepers were in great vogue some years ago but this market has temporarily disappeared.

31. *Dipterocarpus turbinatus*, Gaertn. f. (Gorjan).

Habitat.—A large, evergreen tree occurring in Sylhet, Cachar and the Lushai Hills.

Supplies.—About 1,200 tons may be annually available from the province.

Qualities of the wood.—Sapwood pale reddish white ageing to brownish or reddish white ; heartwood reddish with numerous resin canals at close intervals ; light to moderately heavy ; somewhat interlocked grain ; even and coarse texture ; 40 lbs. per cubic foot ; slightly stronger and considerably harder than Teak ; seasons slowly ; slight tendency to cup, warp and split ; durable under cover ; fairly so in the open ; not immune from attack of borers and white ants ; untreated sleepers have a life of five years ; treats easily with antiseptics ; treated sleepers have a life of fourteen years ; easy to saw and work and polishes well after a good deal of filling.

Uses.—Rafters, planking, scantlings in constructional work ; dugouts, packing cases and tea boxes ; wagon bottom-boards, floorings.

32. *Duabanga sonneratioides*, Ham. (Khokon, Bandarhulla, Ramdala).

Habitat.—A large tree with a clean stem of 35—40 feet, generally found on river-banks all over the forests of the province.

Supplies.—About 200 tons may be annually available from the province.

Qualities of the wood.—Grey, often streaked with yellow to nut brown ; heartwood not distinct ; rough feel ; very light straight or shallowly interlocked grained in broad bands ; very coarse textured ; 24 lbs. per cubic foot; moderately strong and hard ; not a refractory timber to season ; girdling the tree and allowing to stand for eighteen months followed by conversion best ; green conversion also satisfactory ; seasoning in the log gives poor results due to excessive splitting and fungus ; kiln seasons well ; not durable when exposed ; lasts well under cover or in contact with water ; not the class of timber requiring antiseptic treatment ; saws without difficulty ; easy to work by hand tools though requiring considerable care to bring to a good surface ; easily peeled on a rotary cutter and makes up into a strong, pleasing ply-wood.

Uses.—Much in demand for tea-boxes and dugouts also for light constructional work ; sometimes used for furniture.

33. *Garuga pinnata*, Roxb. (Jateri).

Habitat.—Occurs sporadically all over Assam forests.

Supplies.—No accurate data available ; small quantities of logs can be supplied from all Divisions.

Qualities of the wood.—Sapwood large, white and very liable to grey stain ; heartwood reddish brown ; light to moderately heavy ; straight or somewhat spiralled or interlocked grained ; uneven and coarse textured ;

41 lbs. per cubic foot ; moderately hard and strong ; sapwood liable to insect attack, sap-stain and decay ; heartwood remains in good condition ; some amount of cracking, splitting and twisting take place in seasoning ; water-seasoning best ; heartwood fairly durable ; sapwood perishable ; easy to saw and to work by hand and machine ; works up to a smooth surface and takes a good finish.

Uses.—The heartwood should make up into handsome furniture.

34. *Gmelina arborea*, Linn. (Gomari).

Habitat.—Common throughout the province especially in the mixed deciduous forests and *sal* forests attaining a girth of 5'—6' and about 30' useful bole.

Supplies.—About 300 tons may be annually available from all over the province ; main sources of supply—Goalpara, Garo Hills, Kamrup and Sylhet.

Qualities of the wood.—Yellowish to reddish white when first exposed ageing to light russet or yellowish brown ; heartwood not distinct ; lustrous with a smooth feel, very light to light ; straight or more or less irregular or interlocked grained; medium coarse textured; 30 lbs. per cubic foot; moderately hard; distinctly strong and elastic; seasons well without warping or cracking rapidly provided ordinary care is taken in stacking ; girdling gives the best results although in this method there is the danger of insect attack in the sapwood ; green conversion reduces this chance ; easy to kiln season, durable under cover and in contact with water ; white ants do not attack it until the bitter principle is lost ; house-posts in Burma lasted 50 years ; saws and works well to a fairly smooth finish ; takes a good polish and should stain well for furniture work ; not ornamental.

Uses.—One of the best and most reliable timbers but unfortunately not found in large quantities ; used for all general utility purposes and carpentry work in the Surma Valley and to a less extent in the Assam Valley.

35. *Hymenodictyon excelsum*, Wall. (Bhurkandi).

Habitat.—Mixed deciduous forests of Kamrup, Nowgong, North Cachar Hills, Sibsagar and Cachar.

Supplies.—Very limited on account of the very scattered occurrence of the species.

Qualities of the wood.—White when exposed ageing to light yellowish grey ; heartwood not distinct ; rough feel ; light ; straight grained ; medium coarse and even textured; 32 lbs. per cubic foot; moderately soft; not a strong timber ; seasons very well whatever the methods employed ; stacking in the open in vertical stacks should do much to reduce damage due to fungus and mould growth ; rapid seasoning immediately after conversion recommended; not durable when exposed or in contact with the ground ; fairly durable under cover ; liable to attack by borers especially if log is not barked ; stands extremely well in the finished state ; never antiseptically treated ; treatment likely to be easy ; easy to saw and machine and turns well requiring little hand finishing ; polishes to a good surface but absorbs much polish and gives a dull surface ; can be stained to any desired colour.

Uses.—Planking, packing cases ; cheap furniture ; match boards ; barrels ; rather approaches beechwood.

36. *Kayea assamica*, King et Pruin. (Sia Nahor).

Habitat.—A large-sized evergreen tree occurring in the Lakhimpur and Sibsagar Divisions.

Supplies.—A. R. Thomas, as quoted by Pearson and Brown, estimates the annual ourturn as 40,000 c.ft. from the province.

Qualities of the wood.—Light red to reddish brown with a hardly distinguishable heartwood ; heavy interlocked grained ; fine textured—comparable to Mesua in structure but lighter in colour and weight and softer ; 55 to 58 lbs per cubic foot ; liable to surface cracks ; air seasoning of a few converted sleepers and planks were successful (Thomas); not durable in water or in exposed positions ; very hard to work.

Uses.—Suitable for internal structural use.

37. *Kayea floribunda*, Wall (Korol).

Habitat.—A large tree occurring in the evergreen forests of Cachar and the Lushai Hills.

Supplies.—Not exploited now ; amount of sustained supply not known.

Qualities of wood.—No useful information available.

38. *Lagerstroemia flos-reginae*, Ritz. (Ajhar, Jarul).

Habitat.—A middle-sized tree growing in moist localities all over the forests of the province ; generally has a branchy crown.

Supplies.—About 1,500 tons may be annually available from the whole province.

Qualities of the wood.—Sapwood greyish white to pale roseate white ; rather wide ; heartwood light red turning to light reddish brown with age ; rather lustrous with smooth feel ; light to moderately heavy ; straight grained or nearly so ; medium coarse textured ; 40 lbs. per cubic foot ; not difficult to season ; best method of seasoning is by conversion when green and keeping in well-piled open stacks or by girdling the trees and leaving them standing for one year and then felling and seasoning the material in open stacks ; liable to crack and split if left in the log ; re-absorbs moisture even after long seasoning ; refractory species for kiln-seasoning ; moderately durable in the open ; durable under cover and in water ; difficult to treat with preservatives ; average life as untreated sleeper 7—8 years ; saws, works and machines well ; finishes to a good surface taking a good, lasting polish.

Uses.—Primary uses for building construction and for ship and dugout manufacture ; formerly used in Assam as untreated sleepers ; used to a limited extent for furniture, cart-construction, ploughs, well-curbs and boxes ; useful for leather cutting blocks.

39. *Lagerstroemia parviflora*, Roxb. (Sida).

Habitat.—A large tree common in the mixed deciduous forests of all Divisions except Lakhimpur and Sadiya.

Supplies.—Trees are not at present exploited ; about 1,000 tons may be available at least if a demand arises.

Qualities of the wood.—Sapwood pale white to brownish grey ; heartwood light brownish grey to yellowish brown, rather darker towards the pith ; rather lustrous ; works to a smooth surface ; moderately heavy ; straight grained or nearly so ; medium coarse-textured; weight 47 lbs. per cubic foot; very strong and hard timber ; equal to teak in strength to withstand compression and in strength parallel to the grain ; and is more than twice as hard both on the side and ends ; difficult to season satisfactorily ; best results obtained by allowing the trees to stand girdled for one year and allowing the planks to be stored for 6 months to a year ; leaving the trees girdled for a longer period causes borer damage ; water seasoning satisfactory ; kiln-seasoning possible ; durable ; lasts 5—7 years in an untreated state as a sleeper;

takes up antiseptic irregularly under pressure ; when green not difficult to saw ; when dry, saws do not run true due to the twisted nature of the fibre ; machines well ; finishes to a shining smooth surface ; takes a good polish but requires careful filling.

Uses.—Not used at all in Assam ; in Bombay, Central Provinces and Madras, used for constructional purposes and as posts ; suitable for tool handles ; suitable for leather cutting blocks.

40. *Lophopetalum fimbriatum*, Wight. (Sutrong)

Habitat.—An evergreen tree occurring in Sylhet, Cachar and Darrang Divisions.

Supplies.—About 50 tons probably ; main supply from Sylhet and Cachar Divisions.

Qualities of the wood.—Uniform pale yellow to pale pinkish or pinkish grey with a faint yellow ca t ; somewhat lustrous ; light, straight grained medium and even textured ; weight 34 lbs. per cubic foot ; moderately hard and strong like Gmelina arborea ; not difficult to season ; neither warps nor twists ; not durable in the open or in contact with the ground ; under cover, durable and keeps its colour ; not very subject to insect attack ; nice wood to work with hand tools and not difficult to saw ; takes a good polish.

Uses.—Used for boxes ; suitable for all general carpentry purposes.

41. *Machilus odoratissima*, Nees.

and

42. *Machilus bombycina*, King.

Do not occur in sufficient quantities to deserve a description.

43. *Manglietia insignis*, Blume.

Habitat.—A large evergreen tree common in the evergreen forests of the Lakhimpur, Sibsagar, Sylhet and Cachar Divisions.

Supplies.—Obtainable in very small quantities from the above Divisions.

Qualities of the wood.—White, through shades of grey to yellow in colour; moderately heavy and hard ; straight and even-grained ; medium textured ; easy to saw and works well under tools.

Uses.—Suitable for general carpentry work and light constructional work ; used as planking and scantlings in house construction.

44. *Mesua ferrea.*—Linn. (Nahor, Nageswar)

Habitat.—A large evergreen tree found in moist, well-drained evergreen forests in the Sadiya, Lakhimpur, Sibsagar, Darrang, Nowgong, Cachar, Sylhet and Haltugaon Divisions.

Supplies.—The major sources of supply are the Sadiya. Lakhimpur and Sibsagar Divisions. Mature stock has been heavily depleted owing to past exploitation except in Sadiya. About 2000 tons may be available annually from the province.

Qualities of the wood.—Sapwood whitish or pinkish brown heartwood deep claret ; extremely heavy ; interlocked grained ; fine textured ; the hardest, heaviest and strongest wood of the family Guttiferae ; 67 lbs. per cubic foot ; seasons slowly and liable to crack ; very durable timber lasting upwards of 12 to 14 years as a sleeper, rarely attacked by white ants ; refractory to saw when green and almost impossible if seasoned.

Uses.—For Railway slepeers and as a constructional timber, mainly in the form of posts and beams.

45. *Michelia champaca*,—Linn. (Titasopa-Champ)

Habitat.—A large, white-barked evergreen tree growing to about 100' in height and large girths. Frequents well-drained but moist land in the Lakhimpur, Sibsagar, Cachar, Sylhet, Nowgong and Haltugaon Divisions.

Supplies.—About 6000 tons of this timber are estimated to be annually available from the province : the major supply will be from the Sibsagar and Haltugaon Divisions.

Qualities of timber.—Sapwood white ; heartwood light yellow to brown ; straight-grained, even and medium textured ; 35 lbs per cubic foot ; durable moderately hard, easy to work and takes fine polish ; ordinary air seasoned planks warp badly ; best method of seasoning is by girdling the trees.

Uses.—Mainly a furniture wood ; also used for indoor construction work ; excellent for veneering.

M. oblonga, M. excelsa, M. manii, M. montana, Talauma phellocarpa, Talauma hodgsonii and Pachylarnax pleiocarpa are all timbers having properties and uses similar to M. champaca and not generally distinguished from it commercially.

46. *Michelia excelsa.*

Not generally distinguished from M. Champaca (45).

47. *Michelia manii.*

Not generally distinguished from M. Champaca (45).

48. *Michelia montana.*

Not generally distinguished from M. champaca.

49. *Michelia oblonga.*

Not generally distinguished from *Michelia champaca* (45).

50. *Morus laevigata*, Wall. (Bola)

Habitat.—A large deciduous tree fairly common all over the province except Kamrup and Goalpara, in which latter place a few trees are reported as occurring near Kukulong.

Supplies.—Very limited ; main supplies from Sadiya and North Lakhimpur.

Quality of the wood.—Sapwood white to yellowish white ; heartwood bright golden brown when first exposed, darkening to reddish brown ; lustrous at first ; becoming dull with age ; working smooth under tools ; light to moderately heavy ; straight grained, medium coarse and somewhat even textured ; ring porous ; 38 lbs. per cubic foot moderately hard to hard : strong and elastic ; seasons well and darkens with age ; kiln-seasoning very satisfactory ; colour retained in this process ; durable under cover and fairly-so in exposed positions ; never been antiseptically treated ; easy to saw ; works to a smooth surface and takes a fair polish.

Uses.—Highly priced for furniture

51. *Lannea grandis.*—Roxb. (Madhabari)

Habitat.—A moderate-sized to large-sized deciduous tree with a spreading crown of rather sporadic occurrence in *Sal* forests and mixed deciduous forests of the province.

Supplies.—Small quantities in the shape of small logs can be supplied from the Goalpara, Garo Hills, Nowgong, Darrang and Kamrup Divisions,

Qualities of the wood.—Sapwood white or yellowish white ; heartwood conparatively small, light pink when freshly cut, darkening with exposure ; good quality ; straight or naturally inter-locked-grained ; medium and even textured ; weight 36 lbs per cubic foot ; heartwood fairly strong, moderately hard ; difficult to season ; takes more time than any other Indian timber ; moderately durable under water ; easy to saw, work and turn.

Uses.—Used in small amounts for planking and agricultural and domestic implements and packing cases ; heartwood used for pencil making in Madras ; heartwood has remarkably fine grain and hence suitable for delicate carving.

52. *Pachylarnax pleiocarpa.*

Not generally distinguished from *Michelia champaca.*

53, *Palaquium polyanthum,* Bentham (Kurta)

Habitat.—A large tree found occurring in Cachar, Garo Hills, Sylhet and the Khasi and Jaintia Hills.

Supplies.—Available in fair quantity—200 tons annually.

Qualities of wood.—Wood reddish ; hard ; pores moderate sized ; medium coarse textured and wavy grained.

Uses.—Used extensively in Cachar as a timber for all general purposes.

54. *Phoebe goalparensis,* (Bonsum)

Habiart.—A large-sized tree found occurring in the Haltugaon, Kochugaon, Darrang, Nowgong and Sibsagar Divisions.

Supplies.—About 500 tons may be annualy available from all over the province ; main supplies from Nowgong, Darrang and Sibsagar.

Qualities of the wood.—Brown or olive brown ; smooth ; even grained ; medium even textured ; hard ; close-grained ; easy to saw and machine ; takes a good polish ; gives a dull finish; seasons well ; does not warp and split easily.

Uses.—A general utility timber mainly used for furniture in Assam ; priced for block-making in Calcutta.

55. *Pinus Insularis,* Royle. (Dieng-kseh. Khasi).

Habitat.—A large gregarious tree up to about 6' girth common in the Khasi, Naga and Lushai Hills and Manipur State between 2,500'—7,000'.

Supplies.—About 1,000 tons may be annually available from the Government forests in Shillong and another 200 tons from private forests in the shape of small poles and fire-wood mainly.

Qualities of the wood.—Sapwood whitish to creamy white ; heartwood light reddish brown to pale brown becoming darker on exposure ; with darker striae ; numerous and conspicuous dark lines along the grain denoting longitudinal resin canals ; dull to somewhat lustrous ; more resinous than any other Indian pine ; works to a smooth surface under tools ; resinous odour in fresh cut sections, light ; fairly straight but more or less uneven grained ; medium coarse textured ; 35 lbs. per cubic foot ; moderately hard about equal to that of 'chir' ; seasons well ; green conversion and open stacking under cover necessary ; durable under cover ; not at all durable in exposed positions ; never been treated antiseptically but treatment should not be difficult ; saws without difficulty ; takes a fairly good polish.

Uses.—Mainly building construction in Shillong ; to some extent used for furniture making ; for the latter purpose a local variety known as red pine having a more reddish colour is preferred.

56. *Polyalthia simiarum*, Benth and Hook.

Habitat.—An evergreen tree occurring in small numbers in well drained forests all over the province.

Supplies.—Large sizes cannot be supplied at present ; very small quantities of small-sized timber are available from the Kochugaon and Nowgong Divisions.

Qualities of the wood.—Pale yellow without distinct heartwood ; moderately hard and strong.

Uses.—Used in local match factories in Bihar ; a fair plank wood ; not at present used in the province.

57. *Quercus griffithii*, Hook f and Thoms.

A very small tree ; house posts are made out of them in Shillong.

58. *Schima khasiana*, Dyer.

The species is of very limited occurrence in the Khasi Hills. All remarks regarding Schima wallichii probably apply *in toto* to this timber also.

59. *Schima wallichii*, Choisy. (Gugra, Kakria).

Habitat.—A large sized tree, a common associate of *sal* in the *sal* forests of the province and in mixed deciduous forests.

Supplies.—About 50,000 tons are estimated to be annually available from the province mainly from Kochugaon, Haltugaon, Garo Hills and Kamrup Divisions.

Qualities of the wood.—Sapwood dingy white ; heartwood light red ; moderately heavy ; more or less twisted grain ; even to medium texture ; works readily under tools; 46 lbs. per cubic foot ; strength low in comparison to its weight ; the degrade during seasoning is heavy ; the best method of air-seasoning this wood is obviously to convert the logs into thick scantlings, stack for two dry seasons and when the material is fully dry and free from stresses, to re-convert it into thinner sizes. It may also be noted here that wood from the outside of a log gives better seasoned material than that from near the heart centre, on account of presence of shakes in the latter, which cause most of the defects to which the wood is liable ; kiln-seasoning produces a nice clean-looking timber which works and planes well, taking a fair polish ; durable under cover.

Uses.—Used locally for construction and plough shares ; also used locally as dugouts ; seasoned timber should be very suitable for joinery work.

60. *Shorea assamica*, Dyer. (Makai).

Habitat.—A very large tree with a fine straight stem found in the Lakhimpur Division on the north bank of the Brahmaputra and the foot hills in the Naga country and the Sibsagar Division. Forms nearly pure forests in restricted areas as in the Joypur Reserve of the Lakhimpur Division.

Supplies.—About 200 tons may be annually available from the above areas.

Qualities of the wood.—Light grey to light brown ; lustrous with somewhat rough feel ; light to moderately heavy ; fairly straight grained, even

slowly but well especially in the log ; trees girdled for 3 years have still 30 per cent. moisture and if the logs are not converted green it is essential to stack between stickers and protect from the sun and hot winds ; girdled teak seasons quicker when converted than ungirdled; veneers cut from green timber season satisfactorily with a little care ; the timber is reliable and durable and so users are careless in storing it ; it requires care and should not be exposed to excessive heat by being left in the hot sun ; easy to saw when seasoned ; somewhat liable to bend if cut in the green state with thin saw ; works easily by hand and machines but requires care as it is liable to chip off at the edges ; a moderately good turnery wood of the coarser class ; works by hand to a good smooth surface and with a little filling takes a fine wax polish ; peels easily on a rotary machine after soaking the logs for 24 hours at 160 degree F.

Uses.—Too well-known to need mention here.

68. *Terminalia belerica*, Roxb. (Bohera, Bhamra).

Habitat.—Found in the mixed deciduous and evergreen forests throughout the province.

Supplies.—About 500 tons annually will be available throughout the province.

Qualities of the wood.—Yellowish gray ; heartwood lacking ; rough feel ; light to moderately heavy ; fairly straight-grained ; sometimes curly grained in the radial plane ; coarse textured ; weight 37 lbs. per c.ft., fairly strong and tough, in this respect being inferior to other Terminalias ; not sufficiently strong for first class sleepers : seasons with little degrade ; liable to stain ; best results obtained by girdling the trees ; kiln-seasoning satisfactory and fairly rapid ; not durable when exposed as decay and insect attacks set in ; moderately durable under cover ; fairly durable under water ; easily treated antiseptically ; easy to saw and machine, difficult to get a good surface ; absorbs a lot of polish and soon loses its lustre ; liable to split ; easy for veneering and a not unornamental veneer with broad patterns is produced.

Uses.—Suitable for blocks and for Jute-bobbins as found in the Bareilly Institute ; may yield a strong plywood.

69. *Terminalia chebula*, Retz. (Hilika, Haritaki).

Habitat.— Found all over Assam, usually of small dimensions in deciduous forests and of large dimensions in evergreen forests.

Supplies.—Probably about 100 tons from all over the province.

Qualities of the wood.—Sapwood grey ; heartwood dark purple ; small, irregular ; dull to lustrous ; smooth feel ; very heavy ; interlocked grained in fairly narrow bands ; often twisted or curly grained or interlocked grained in fairly narrow bands ; medium fine textured ; weight 56 lbs. per c.ft. ; very hard, tough and very strong ; very refractory in seasoning ; develops end-splits if left in the log ; durable in exposed positions ; very durable under cover and in water ; does not require treatment ; difficult to saw, especially when dry ; difficult to work ; finishes to a hard smooth surface ; polishes well.

Uses.—For general constructional purposes ; in Upper Assam, often mixed with better class timber.

70. *Tetrameles nudiflora*, R. Br. (Bhelu, Tula).

Habitat.—A gigantic tree with a clean bole up to 100' and large buttresses, common throughout the province.

Supplies.—Supplies from near floatable streams whence only they can be exploited very limited ; now exploited largely only from the Sibsagar, Nowgong and Cachar Divisions.

Qualities of the wood.—White when first exposed turning to pale yellowish grey ; heartwood not distinct : lustrous with rather rough feel ; very light ; interlocked grained in broad bands ; coarse textured ; a soft, weak perishable timber; 22 lbs. per c.ft.; slightly harder and more brittle than Bombax; holds nails well, an essential property for box-wood ; seasons well without difficulty if protected from insect attack, stain and decay ; badly damaged by borers if left in the log ; water-seasoning results in considerable splitting and decay ; saws with ease and works to a fairly smooth surface ; peels easily and cuts to a clean smooth surface on a rotary cutter and makes up into a strong, serviceable plywood.

Uses.—In large demand for packing-cases and tea boxes ; also for match-boxes.

71. *Terminalia myriocarpa*, Heurck et Muell. (Hollock).

Habitat.—Evergreen forests of Assam up to 2,000 feet in Khasi Hills.

Supplies.—About 10,000 tons will be annually available, mainly from the Sadiya and Lakhimpur Divisions.

Qualities of the wood.—Sapwood light brown, often streaked or brownish yellow ; heartwood light brown, beautifully straited with narrow darker streaks; turns darker with age ; lustrous ; working smooth; moderately heavy : straight-grained ; occasionally somewhat wavy grained ; coarse-textured ; weight 59 lbs. per c.ft. ; strong timber equal in hardness to Teak ; seasons with degrade; surface cracking and end-splitting negligible during seasoning ; when sawing for sleepers, core should be removed ; little tendency to split, warp or twist ; as plywood, does not season well ; not really durable when exposed but durable under cover ; untreated sleepers have a life of about 4 years ; takes antiseptics well ; saws easily when green ; more difficult when dry ; peels easily on a lathe and makes up into a strong plyboard ; often darkens very much with age.

Uses.—In Lakhimpur and Sibsagar, mainly used as a constructional and general utility timber ; in Sadiya mainly cut for plywood tea boxes ; formerly was exclusively used for making dugouts by local people.

73. *Trewia nudiflora*, Linn. (Pitali, Kenlo).

Habitat.—A moderate sized deciduous tree commonly found on stream-banks all over the province.

Supplies.—About 500 tons may be annually available from all over the province.

Qualities of the wood.—White ageing to pale brownish grey ; frequently discoloured by fungal sap-stain ; heartwood not distinct ; lustrous when first exposed but soon becomes dull ; extremely light ; straight grained ; medium fine and even textured ; 28 lbs. per c.ft. ; moderately soft ; considerably denser than many packing case woods such as Bombax ; does not split or warp in seasoning but unless care is taken very liable to blue stain ; should be stored under cover ; never been kiln-seasoned ; not durable in the open and only moderately so under cover ; tea-shooks formerly treated with a mild solution of zinc chloride to keep off insects with good results ; saws with ease and works to a smooth surface.

Uses.—A packing-case and tea-box wood of good quality ; Calcutta match-makers use it extensively ; if carefully seasoned yields a good sound board of the deal class.

74. *Zanthoxylum budrunga*, Wall. (Brojanali).

Habitat.—Sporadically occurring all over Assam forests.

Supplies.—No accurate data available ; small quantities in the shape of small logs can be supplied from all Divisions.

Qualities of the wood.—Canary yellow when first exposed fading to pale yellowish grey ; lustrous with smooth feel ; rather light to moderatly heavy ; straight-grained : fairly even, medium textured ; 41 lbs. per c.ft ; moderately hard and may be classed as equal to *Adina cordifolia* in strength ; appears to season without much degrade ; somewhat liable to grey stain ; moderately durable timber if used under cover, especially if out of reach of white ants ; timber saws easily and works by hand and in a machine to a good smooth surface ; one of the best turnery woods yet tested and would stand up to high-speed repetition lathes and moulding work.

Uses.—Has been tested for matches and match-boxes and provisionally passed as suitable ; should be tried for jute bobbins and could be used for all purposes for which *Adina cordifolia* is used.

A. G. P. (Forest) No.4—2,000—22-8-1940.

Government of Bengal

Forest and Excise Department

Report of the West Bengal Forest Committee

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Introduction.

THE OBJECTS OF THE ENQUIRY.

1. The Western Bengal Forest Committee was appointed by the Government of Bengal in their resolution No. 14670-For., dated 25th July 1938, which is printed as Appendix I to this report. The resolution referred to reports of progressive deforestation and erosion in Western Bengal and to the danger that in consequence Western Bengal was becoming more and more liable to flood and to drought: and it placed upon the Committee the task of determining whether any, and if so what, measures were necessary, in the districts of Midnapore, Burdwan, Birbhum and Bankura, for the conservation of the forests which remained, for the re-afforestation of areas denuded of forests and for the afforestation of areas now unproductive in consequence of deforestation. This task was very similar to that of the Stephenson Committee which inquired into the denudation of forests in Chota Nagpur and Orissa in 1908: and the area covered by the present inquiry adjoins that with which they dealt. It is not a matter for surprise therefore that we have frequently had occasion to make use of their admirable report.

THE COMMITTEE'S TOURS AND MEETINGS.

2. As will become apparent later in this report, these questions could not be answered satisfactorily if the Committee relied for their facts chiefly upon the evidence of witnesses: statistical data were lacking, the subject is complex and no one has systematically or on a wide scale studied the conditions in these four districts. It was, therefore, contemplated that the Committee would depend mainly upon the evidence of their own eyes and should take only such evidence as was necessary to elucidate what they saw. The first two meetings of the Committee (held in Calcutta on 29th November and 13th December, 1938) were devoted to a discussion of the lines upon which they should work. At the first, which Mr. Rai Harendra Nath Chowdhury, Maulvi Abdul Bari and Maharaja S. K. Acharjya Choudhury were unable to attend, it was decided that the Committee should tour as one body in all four districts although this made greater demands upon the members than the alternative system of dividing the districts among sub-committees. The reason for this was that all but two of the members were either ignorant of the problems before them or had but a slight knowledge of them. If they were to understand what they saw in the forests and in areas where forests had once been, they would need the help and the instruction of the two members who were Forest Officers: and it was essential that these two should visit all four districts and should discuss together the various new problems presented by them. It may be mentioned here that the decision to tour with both the Forest Officers proved to be wise: the Committee found that to listen to their discussions was most educative and their elucidation of the principles of forest management, ignorance of which has led to the destruction

of much forest in West Bengal, was most illuminating. At the same meeting it was further decided that it was not sufficient to trust, for the elucidation of any problems raised when we visited the forests, to the extempore examination of such persons as happened to be present, and that it was preferable to let forest-owners and other interested persons know beforehand the type of question that might be put to them and also to give those whose forests could not be visited by the Committee the chance of bringing to notice any facts peculiar to them. Accordingly a questionnaire was prepared for consideration at the second meeting which was attended by all the members except Mr. Syed Mustagawsal Haque, unavoidably absent. In its approved form the questionnaire was distributed through the respective Collectors to owners of forests, to representative tenure-holders, raiyats and others resident near forests, and to the Chairmen of the district and local boards and to selected Presidents of Union Boards. The replies to this questionnaire, which forms Appendix II to this report, were received by the Collectors and considered by the Committee while they were on tour in the areas to which the replies related. At the same meeting a tour-programme covering almost the whole of January was approved.

3. The tour in Midnapore district lasted from the 4th to the 13th January 1939. The Chairman did not join the tour till the 5th, having had to be present at the departure of His Excellency the Viceroy from Howrah on the 4th: the Maharaj Kumar joined only on the 8th: the Maharaja and Mr. Woodgates left on the 10th: and Messrs. B. B. Mondal, Mostagawsal Haque, Simmons, Sen and Ahmad were present throughout. On the 4th the Committee heard witnesses at Midnapore: on the 5th they visited the forests of the Midnapore Zamindari Company at Amlagora and Goaltor; and on the 6th and 7th respectively they visited the forests of the Lalgarh and the Ramgarh Estates. These forests were all in Midnapore Sadar subdivision. On the 8th January the Committee moved to Jhargram and visited the Jhargram Estate forests at Rakhgerya, Bandi, Goradhara and Arjun Dahar. On the 9th they inspected tenure-holders' forest near Jhargram and later heard witnesses. On the 10th they went to Belpahari and saw the Midnapore Zemindari Company's forests at Lachmanpur and Sinduria Hill. On the 11th they visited the Jamboni Estate forests at Chichira and the Dhalbhum forests in Bihar. On the 12th they visited the Mayurbhanj State's forests at Nayabasan. All these are in Jhargram subdivision of Midnapore.

4. The Committee's second tour lasted from the 23rd January to the 31st. The Chairman, the Maharaj Kumar of Burdwan, Mr. B. B. Mondal, Mr. S. M. Haque, Mr. Sen and Mr. Ahmad were present throughout. Khan Bahadur Naziruddin Ahmad joined on the 25th, was called away on the 26th and joined again on the 29th: Mr. Simmons joined on the 25th: Mr. Woodgates on the 26th and Mr. B. C. Mandal on the 29th. On the 23rd January the Committee members met at Burdwan and went by car up the Grand Trunk Road to Kanksha, where, turning up the Ilambazar road, they went to Aduria near the boundary of Birbhum district. It would have been convenient to go straight through to Suri: but instead they returned to Kanksha and went up the Grand Trunk Road to Ondal, with a view to getting an idea of the condition of the forests along that road. This part of the tour was disappointing: for we had run short of time and were unable to stop and enter these forests. On the 24th January the Committee

went from Suri to Rajnagar and back, examining several interesting forests on the way and at Rajnagar itself: they also examined witnesses at Suri. On the 25th they went via Bolpur to see the Chowpahari forests in the south of the district, and afterwards examined some witnesses at Bolpur. On the 26th they left Birbhum. At Raniganj they examined witnesses all the morning: and in the afternoon they crossed the Damodar river and proceeded to Bankura, visiting on the way forests of the Maliara Estate at Latiaboni and of tenure-holders near Gangajalghati. Next day they went to Taldangra, stopping on the way to see the forests of tenure-holders at Ratanpur: they examined witnesses at Taldangra and at Medinipur on the road to Onda, by which place they returned to Bankura. On the 28th they went to the Burdwan Raj forests at Patharmara via Sonamukhi, stopping en route to see forests at Beliatore. On the 29th they examined witnesses at Bankura, before going to see denuded land and the scant remains of forests near Susunia, Saltore and Jhantipahari. The tour ended with a visit to forests, in Vishnupur subdivision, near Basudebpur, where witnesses were examined.

The Committee recorded the evidence of 16 witnesses in Midnapore, 7 in Birbhum, 14 in Burdwan and 42 in Bankura. It must not be thought that witnesses were examined only at the formal sittings held for the purpose: many were examined informally in the forests, where they illustrated their evidence by pointing to the condition of the trees and the soil around us. The Secretary examined one firewood merchant of Sealdah in Calcutta and one at Howrah.

5. The third tour of the Committee was to Dacca: it lasted from the 23rd to 28th February. Only five members were able to go on this tour. They were Khan Bahadur N. Ahmad, Mr. B. B. Mandal, Mr. Simmons, Mr. Sen and Mr. Ahmad. The purpose of their tour was to see a private forest under Government management: they visited the Bhowal forests.

6. Five meetings were held in Calcutta during the first week of July to discuss the draft report.

PART I.

DEFORESTATION IN OTHER COUNTRIES.

EROSION IN OTHER COUNTRIES.

7. The absence of statistical evidence as to the destruction of forests and the progress of erosion is a great handicap. It makes it difficult to bring the reality of the danger home to the imaginations of people who have not toured among the forests themselves under the guidance of an expert forest officer. To any one who has made such a tour and who has in different areas compared forests and soils in the different stages of deterioration, it is obvious that forests are vanishing and that the soil is being denuded in the districts of Midnapore, Bankura, Birbhum and Burdwan, though by no means at an equally rapid rate in all. But those who have not made such a tour will be slow, even if they know the districts in question, to believe that the danger of wholesale destruction of forests and the wholesale loss of the surface soil can be as serious as the Committee believe it to be. The danger to the forests is obscured by the marvellous power of recuperation which characterises the sal tree: and the extent to which the soil is being eroded is disguised by the fact that the process is almost imperceptible. Everyone knows that the muddy rain water which flows down into the streams carries a certain amount of soil in it: but it is hard to believe that it carries away enough to remove layers of soil several feet deep in a short period. It is therefore necessary to show that erosion of soil is a thing which is recognised as having happened in all parts of the world; and that in many countries the Governments have been compelled to take action against it. This task will be the easier because there have lately been published two reports which present many of the facts in an accessible form. These are first the "Proceedings of the British Empire Forestry Conference" held in South Africa in 1935, and secondly Technical Communication No. 36 of 1938 of the Imperial Bureau of Soil Science, on "Erosion and Soil Conservation" by G. V. Jacks and R. O. Whyte.[1] These should be consulted by every one who has an interest in the subject. The essential thing to remember about erosion is that the soil remains intact so long as good cover is afforded to it by grass, shrubs or trees: when the cover becomes thin or disappears, erosion begins. If the soil is extremely light and lacks any binding material, it is carried away in dry weather in the form of fine dust by strong winds: this is wind erosion which is often associated with shifting sand dunes. For our purposes erosion by the action of water is more important: one form of this is sheet erosion which means that whole layers of surface soil are removed: the other is gully erosion, which means that the water cuts itself channels in the soil which gradually become deeper and wider and sometimes lead to the complete destruction of wide areas. Gully erosion is more spectacular than sheet erosion but it does not do more damage. In the following paragraphs instances of wind erosion will be quoted because there happens to be a lot of recent information about

[1]They are referred to later in this report as "British Empire Forestry Conference" and "Technical Communication No. 36", respectively.

them: there is no serious wind erosion in Western Bengal: but it is always the destruction of tree-cover or grass-cover that allows erosion to occur, whether by wind or by water, and our immediate purpose is to show what amazing physical changes erosion, in all its forms, has produced elsewhere.

Erosion in the United States of America.

8. Most people will probably need no reference to printed reports to be reminded of the manner in which the great wheat growing tracts of the United States of America were reduced to ruin by erosion only two or three years ago. The newspapers then were full of reports about erosion in what was called the "Dust Bowl" area, because clouds of dust carried by the wind from the farms in it darkened the sky for a distance of many hundreds of miles.[1] The Dust Bowl meant the "Great Plains Regions" of the North-west, the Centre and the South of the United States. In this vast area, the mixed grasses and herbs which had protected the rich prairie lands had been destroyed by ploughing when they were brought under cultivation, or their character had been so modified by grazing, burning or hay-making that in a prolonged drought they died and left the soil without cover. The result was wind-erosion: the surface soil was removed in the form of clouds of fine dust and the sub-soil disintegrated into sand which drifted in great waves across the country. Over hundreds of square miles cultivation became impossible, much land will probably never become cultivable again, and it became necessary to put under trees belts of farm land amounting in all to about 1,000,000 acres in a zone 100 miles wide stretching across the United States from the Canadian border down to the Texas Panhandle.[2]

9. The erosion in the "Dust Bowl" was not due to destruction of forest or of tree-cover and was not due to water action such as is to be feared in Bengal: it was due to the destruction of grass cover and to the action of wind: the principle is the same but its manifestation is different. More directly apposite is the erosion in the Piedmont country which lies in the Southern States of Virginia, North Carolina, South Carolina, Georgia and Alabama. It is rolling foothill country of the Appalachian Range and used to be covered with magnificent forests when it was first settled. In 1934 it was found that, out of a total of about 40,000,000 acres, 12,000,000 acres had lost more than three quarters or even all the surface soil; great sections of the area were disfigured and defaced by gullies; and most of the remaining 12,000,000 acres had suffered in varying degrees. Between 1920 and 1930 some 50,000 farms went out of cultivation in that part of the area which lies in the Carolinas and in Georgia; lands have been buried by the deposition of eroded materials; and 13 out of the 56 larger reservoirs of the southern Piedmont have been completely filled with silt.[3]

10. Detailed figures[4] are available for the "Corn Belt States" of Minnesota, Wisconsin, Illinois, Iowa and Missouri, which lie to the

[1] British Empire Forestry Conference, page 10.
[2] Technical Communication No. 36, page 158.
[3] Technical Communication, pages 151-152.
[4] Technical Communication, pages 153-154.

east of the Great Plains Regions and which contain half the first-grade land of the United States. In the state of Iowa, which is typical, conditions were shown by a survey in 1934 to be as follows:—

	Per cent.
(1) Little or no erosion	13
(2) Slight erosion (loss of a quarter of the surface soil or less)	35
(3) Moderate erosion (between a quarter and half of the surface soil lost)	14
(4) Serious erosion (between half and three quarters of the surface soil lost)	31
(5) Very serious erosion (over three quarters of the surface soil lost)	9

The figures for the State of Missouri corresponding to these were as follows:—

	Acres.	Percentage.
(1) Slight or no erosion	10,000,000	22·7
(2) Moderate erosion ($\frac{1}{4}$ to $\frac{1}{2}$ surface soil lost)	12,000,000	27·3
(3) Serious erosion ($\frac{1}{2}$ to $\frac{3}{4}$ surface soil lost)	20,000,000	45·4
(4) Very serious erosion (over $\frac{3}{4}$ surface soil lost)	2,000,000	4·6
Total area ..	44,000,000	

Such figures as these considered in the light of the fact that the total area of the four West Bengal districts with which we are dealing is only some 1,200 square miles, or 7,680,000 acres, show that erosion to the extent which the Committee believe to have occurred in them is not at all improbable. But, striking as they are, the figures already quoted are as nothing compared with those for the United States as a whole. There is no other country where even an approximate estimate has been made of the damage done by erosion: but in the United States there has been "a preliminary reconnaissance erosion survey" made "county by county" in 1934. The information collected is summarised in the following table[1]:—

	Acres.	Per cent. of area surveyed.
(1) Obviously unculturable (mountains, deserts, etc.) ..	145,000,000	7·5
(2) Hardly, if at all, eroded (much of it not adapted to agriculture)	578,000,000	30·3
Total not affected by erosion ..	723,000,000	37·8
(3) Moderate to severe gully erosion—no sheet erosion..	111,000,000	5·8
(4) Moderately or seriously eroded ($\frac{1}{4}$ to $\frac{3}{4}$ surface soil lost)	791,000,000	41·6
(5) Very seriously eroded (over $\frac{3}{4}$ surface soil lost) ..	170,000,000	8·9
(6) Destroyed for cultivation (all the surface soil lost) ..	113,000,000	5·9
Total affected by erosion	1,185,000,000	62·2
Grand Total	1,908,000,000	100·0

[1]Based on the diagram on page 122 of Technical Communication No. 36.

Erosion in Canada.

11. There are statistics also for the damage done by erosion in the three Prairie Provinces of Canada, Manitoba, Alberta and Saskatchewan, in which are situated 69 per cent. (38,700,000 acres) of the land under field crops in the whole of the Dominion. In 1934, 8,457,000 acres in these three provinces were affected by soil-drifting. This soil was the product of erosion: the fibrous root-material left in the surface soil when the original vegetation was destroyed had disappeared and, when prolonged drought prevented the growing of a cover-crop, the light soil, left with no binding matter in it, was carried away by the wind. Most of the land affected was prairie land but in Manitoba there are tracts, known as the Spruce Woods, which were until the late eighties quite densely wooded but which as a result of indiscriminate cutting and timber stealing are now seriously denuded.[1] In most of the East of Canada erosion is comparatively slight, but in Quebec province it is a problem. In various parts of the province there are numerous areas, some large and some small, where sand-dunes have been formed as a result of clearing forest off land not really fit for cultivation.

Erosion in China.[2]

12. China is another country where erosion has proceeded on a colossal scale. The loess-soil of North China is said to be the most erodible soil in the world; gigantic gullies, 300 feet and more in depth, are cut in it by the torrential streams and "present some of the most striking pictures known of the power of erosion". The Yellow River which drains this area carries away each year about 2,500 million tons of soil, sufficient to raise by 5 feet an area 400 square miles in extent: some of this is deposited as fertile soil but the gain "is insignificant compared with the losses from floods, famine and desolation produced in the densely populated plains by erosion." In many parts of Central and South China whole hillsides have been completely eroded: whole districts have been rendered almost barren: the farmers "commonly burn all forest and bush land each year to destroy hiding places of wild beasts or so that the ashes may be washed down to fertilise the paddy fields in the valleys," and this prevents natural forest reproduction which would check the erosion. In South China sheet erosion has been particularly severe: the original surface soil and upper subsoil have now largely disappeared, and the heavy granular subsoil has been left exposed to gully erosion. In North China there is wind erosion: and the extension of cultivation on the sandy regions bordering Inner Mongolia is producing a new source of dust and leading to the gradual encroachment of the desert.

Erosion in South Africa

13. "Soil erosion has already transformed parts of South Africa's richest pastoral country into semi-desert," and "in no other country have the disastrous consequences of erosion followed so quickly after

[1] British Empire Forestry Conference, page 26.
[2] Technical Communication No. 36, pages 59-61.

its commencement."[1] At the British Empire Forestry Conference Mr. Thornton, an Agriculturist, stated as follows[2]: "the desert is rolling in and taking a great portion of this country from us, due to the destruction of tree growth.....we know of three low climax periods of rainfall periods in the years 1802-03, 1862-63 and 1932-33. In these periods it looked as though the desert had taken possession. The dust drove over from the west and covered the Free State, and in many parts there was a layer half an inch thick. Trees would have prevented this wind erosion as they do erosion by water. Trees are the best agent for slowing down waterflow and for the slowing down of wind velocity near the surface of the earth." There was a Drought Investigation Commission which reported in 1923 that soil erosion, both gully and sheet, was extending rapidly; that this led to the loss of enormous quantities of the soil which was limited in amount and irreplaceable, the silting up of reservoirs and irregularity in the flow of rivers; that it was accompanied by a marked decrease in the underground water supply; and that it was "caused by reduction of the vegetable cover". The most important causes of erosion were thought to be burning of grass (which led to hardening of the surface and increased run-off of rain-water), deforestation and the construction of roads and railways. The British Empire Forestry Conference said in their report that in the area now comprising the Union of South Africa there was within historic times a much greater area of natural forest than now exists and that its condition was far better than at the present day; and that the disturbance of natural conditions which attended the development of the country has had serious effects. They concluded that "in dealing with the erosion problem the planting of trees can be as beneficial in South Africa as in other countries confronted with the same problem."[3]

Miscellaneous instances of water-erosion.

14. It would be an unprofitable task to summarise in this report all the information available as to soil erosion: but lest anyone should imagine from the instances already quoted that only wind-erosion is of real importance, it seems advisable to mention some more countries where the destruction of forests has led to erosion by water-action. Among these are practically all the lands lying round the Mediterranean sea. Originally well-wooded they are now devoid of forest, except in the south of France and the north of Italy: the soils are for the most part such as are easily eroded after the torrential rains which fall in the winter: and much of the original surface soil has been washed off the land and carried down into the sea.[4] North Africa where there were fertile corn fields in Roman times is now largely desert. In the French Pyrenees there has been "almost catastrophic erosion". In Cyprus since the destruction of the forests "the numerous streams and winter torrents rushing down from the mountain ranges during the rains remove enormous quantities of soil which is either distributed over the plains as a thin layer of very erodible silt or carried out to sea"[5]

[1]Technical Communication No. 36, page 67.
[2]British Empire Forestry Conference, page 32.
[3]British Empire Forestry Conference, page 5.
[4]Technical Communication No. 36, pages 7-8.
[5]Technical Communication No. 36, pages 12-13.

Conditions in Greece are similar. In Asia Minor "deforestation combined with high rainfall" has led to serious erosion along the south of the Black Sea: there is erosion on the west and south coasts and in Central Anatolia also where the torrents bury rice-fields beneath the detritus carried down by them[1]. In Palestine the destruction of many of the scrub forests which used to cover the hills has been followed by the complete removal of the soil and the complete cessation of springs over large tracts of country: and erosion is so widespread that the chief aim of the Department of Forests is to deal with it. Water-action is the most important factor in regard to erosion in Ceylon also. "Intense falls of rain are the main cause of much serious erosion . . . . particularly where the land is at all undulating and the natural surface-vegetation has been removed."[2] In the Dutch East Indies erosion and particularly sheet erosion are of importance: they are associated with deforestation, "which has assumed catastrophic proportions", "chiefly owing to the unsystematic clearance of land for agricultural purposes."[3] In the Philippines "catastrophic erosion in places is serious," according to Professor Pendleton[4], short rivers with steep gradients carrying with them a vast amount of material eroded from the land-surface." In Japan erosion by water which carried the debris over cultivated land has been held in check only at vast expense.[5] In Tasmania during heavy rains large quantities of the red, brown and chocolate soils are frequently removed from the sloping ground. "Often as much as one inch of surface soil may be removed in a rain storm. Instances have been observed where over a period of years the whole of the surface soil has been removed, either being washed into streams or lodged lower down the slope. Owing to the slight change in colour between the surface soil and subsoil in these areas, and to the fact that the type of soil removal is generally sheet erosion, this loss of surface soil is not readily detected by the untrained eye."[6] Similar examples might be adduced from almost every part of the world, except South America regarding which the Committee have no data. But they will quote here only one more before dealing with examples from India. It will be necessary later to quote some figures collected by Russian Scientists as to the observed rate of erosion and it is therefore appropriate to mention that erosion in the Soviet Union is fairly extensive and has been increasing since the land was handed over to the peasants: "there are huge regions in the U.S.S.R. where . . . . . whole territories formerly under profitable agriculture are now occupied by immense ravines and infertile wastes"[7]: that it is water and not wind which is the eroding agent is proved by references to extensive gully erosion.

Erosion in India.

15. R. M. Gorrie, quoted by Jacks and Whyte[8] has pointed out that the increase of cattle associated with the growth of population in

[1]Technical Communication No. 36, pages 15-16.
[2]Technical Communication No. 36, pages 41-42.
[3]Technical Communication No. 36, pages 47-49.
[4]Technical Communication No. 36, page 52.
[5]Technical Communication, pages 62-64.
[6]Technical Communication No. 36, page 203.
[7]Technical Communication No. 36, page 21.
[8]Technical Communication No. 36, page 32.

India, in areas where grass-lands can persist only under reasonable treatment, has caused the disappearance of grass over very large tracts and left the livestock dependent upon bush and tree growth for their day to day existence. "In most other countries livestock are maintained on a ration of grass and the bush growth which occurs in the grazing grounds is looked upon as a natural reserve which should be used only in times of acute scarcity: in much of India the last vestiges of shrub growth already form the ordinary daily ration for the village herd. The amount of erosion caused directly through this state of affairs has to be seen to be believed." The most serious erosion is evident among the Indian foothills and their outlying slopes where gullies and floods are devastating large areas. "When the Emperor Jahangir built the castle of Nurpur for his queen, Nurjahan, he writes in his memoirs that the forest was so thick that a bird could hardly spread its wings. But if you go to that place to-day, you will see nothing but a denuded hill-country with hardly more than a few tufts of grass and thorn bush on which a few goats eke out a miserable existence." The forests which the nobles in the old days preserved as hunting grounds have been utterly destroyed by the villagers "by burning, cutting and grazing" and the soil has been eroded to such an extent that, in a picture shown to the British Empire Forestry Conference by Mr. C. G. Trevor, now Sir Gerald Trevor, late Inspector-General of Forests in India, from whom the above remarks are quoted,[1] a masonry well stood high above ground-level like a watch tower. The surface of the land used to be level with the top of the well and the cultivated land in which the well was made has become a dry and sandy river bed. Mr. Trevor concluded that first among the several causes of erosion came the destruction of the forests. But although erosion may be worst in the foothills of the Himalayas (including those north of Bengal), it is bad in almost every province of India: Central India, the Central Provinces, Hyderabad, Bombay, Madras, Assam, the United Provinces, the Punjab,—in all of these according to the reports gathered by Jacks and Whyte, and in Chota Nagpur and in Orissa according to the Stephenson Committee, erosion has become a serious evil. It is unnecessary to insist on this because everyone in Bengal is aware that the delta is built up of the silt brought down by rivers from eroded areas, in the mountains and in the plains, of Upper India: the size of the delta is an index of the extent of the erosion which led to its creation. But it is an interesting fact that there has recently been a formal pronouncement on the subject not by foresters but by irrigation experts: it will be found in Quarterly Bulletin No. 12 of the Central Board of Irrigation, 1938, which quotes a resolution of the Board running as follows:—

"The Board is convinced that the evils of denudation in India are so serious and widespread that action for its further prevention should be taken without further delay.

Denudation causes high floods in summer and low river levels and small supplies on winter, which result in:—

(*a*) damage to canal systems through interference with the regularity of canal supplies;
(*b*) harmful deposits of sand;
(*c*) interference with river navigation; and
(*d*) widespread damage to the countryside."

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[1]British Empire Forestry Conference, page 15.

SOIL LOSSES FROM EROSION.

16. Soil erosion was declared by the Russian Scientist, Pankov, to be a new natural phenomenon created by human intervention and capable of regulation by human intervention. It is natural to inquire how quickly it shows its results. The chief work on this has been done in the United States of America and in Russia, where there has been in recent years a good deal of careful research on the loss of soil by sheet erosion under different systems of agriculture. It need hardly be said that the rate of loss varies greatly according to the slope of the land, the nature of the soil, the quantity and distribution of the rainfall and the extent to which the system of cultivation adopted exposes and disturbs the soil.

The following table shows what different effects result from different methods of cultivation and cropping: it is based on fourteen years' research at the Missouri Experimental Station, Columbia, U.S.A. The soil was loam, the area was 90·75′ long, the slope was 1 in 27, and the rainfall was 37 inches per annum.

Cultural and cropping system followed.

	Ploughed 4″ fallow.	Ploughed 8″ fallow.	Continuous blue grass.	Continuous wheat.	Rotation corn, wheat and clover.	Continuous corn.
'verage number of tons of soil eroded per acre per annum.	41·64	41·08	0·34	10·10	2·78	19·72
Surface erosion in inches per annum.	0·291	0·287	0·0023	0·070	0·019	0·138
Average number of cubic feet of run-off per acre per annum.	46·132	45·836	18·379	35·209	21·129	44·524
Average run-off per cent. per annum.	30·7	30·3	12·0	23·3	13·8	29·4
Number of years to erode 7 inches of soil.	24	24	3043	100	368	50

Further indications of the effect on erosion of different systems of cultivation are to be found in Q.C. Ayres' book on "Soil Erosion and its control" from which the following figures are taken: they show the average number of days in the year during which the soil is left exposed under each system mentioned—

Fallow land	...	365
Continuous blue grass	...	...
Continuous wheat	...	91
Rotation of corn, wheat and clover	...	73
Continuous corn	...	207

They have an indirect bearing on the problem of forest management because exposure of soil to weathering will vary quite as much with

different methods of forest management as with different systems of cultivation. More direct evidence on this point is afforded by the following summary of the results of experiments on sandy loam in Eastern Texas and Central Oklahoma by Tyler and Guthrie in 1934:—

Mean rainfall inches.	Slope.	Cover.	Soil-loss tons per acre.	Run-off per cent.
44·4 ..	1 in 8	Forest	0·01	0·80
		Forest, litter burnt	0·19	2·60
42·3 ..	1 in 11	Grass	0·21	1·50
48·8 ..	1 in 6	Grass	0·00	0·70
33·5 ..	1 in 18	Forest	0·017	0·13
		Forest, litter burnt	0·22	5·06
32·9 ..	1 in 13	Grass	0·04	1·50

These results seem to show that forest as well as good crops of grass afford practically complete protection from erosion on certain types of soil. The effect of burning the forest litter is an increase in the soil-loss and in the amount of rain that runs off.

17. When forest is managed under a system of clear-felling the length of the rotation plays an important part. If the rotations are very short, the soil is exposed at frequent intervals and the chances of damage to it are so much the greater: with longer rotations the ground is covered with trees long enough for the natural process of weathering and decomposition of humus and leaf-litter to replace the soil which is lost by exposure when an area is clear-felled.

18. In Russia Pankov found that in typical areas the annual loss by erosion per acre was between 0·8 and 1·2 tons in the north, between 2 and 3·6 tons in the Steppes regions and between 8 and 20 tons in the subtropics. [1]Gussak's work at the Tiflis Research Institute shows that there were average losses per annum of 8 tons per acre on gentle to moderate slopes and 20 tons per acre on steep slopes under plantation-agriculture (tea, tobacco, citrus) and that these would result in the complete removal of the surface humus in from 10 to 20 years.

19. In Ceylon, Holland and Joachim found that under three different methods of cultivation customary on tea estates the loss of soil in six years was 101·8, 56·7 and 92·4 tons per acre, respectively; and, working with Panditteseker, Joachim found that the Mahawe Ganga, the longest river in Ceylon (206 miles) carried at Peradeniya, not even half-way between its source and its mouth, from 130,000 to 820,000 tons of silt per annum. Though the size of the catchment area of this river between its source and Peradeniya has not been estimated, it cannot exceed half a million acres: and the average loss of soil per acre in it would therefore have been from ·26 to 1·6 tons per annum.

20. In Tanganyika experiments were undertaken in 1933-34 and 1934-35 to ascertain the run-off and the soil loss at the Mpwapwa Experimental Station with the following results.[3] The soil was

[1]Technical Communication No. 36, page 23.
[2]Technical Communication No. 36, page 27
[3]Technical Communication No. 36, pages 91-92.

"coarse sandy friable loam", and the rainfall was 27 inches in the first year and 22 in the second: the rain falls mostly in torrential downpours.

Plot No.	Treatment.	Percentage run-off.		Soil-loss tons per acre.	
		1933-34	1934-35	1933-34	1934-35
1	Bare; uncultivated ..	52·9	47·8	56·85	59·92
2	Bare; flat-cultivated ..	34·8	28·2	48·82	54·64
3	Bare; ridge-cultivated ..	25·2	20·8	12·71*	27·14
4	Bulrush millet (1933-34) *mlama* (1934-35)	29·1	22·9	40·35	34·35
5	Perennial grass	2·8	0·9	..	..
6	Bare; flat-cultivated	33·3	27·1	22·78	15·17
7	Deciduous thicket A ..	..	0·5	..	
8	Ditto B ..	..	0·4	..	..

*This figure for soil loss is for slightly less than half the season's rainfall.

The slope of the first six plots was 1 in 15 and that of the last two, which were added in 1934-35 to obtain data from land under natural vegetation, was 1 in 13.

21. In East Africa, Gethin Jones considered[1] that very large areas under native cultivation on fair slopes would lose 10 to 40 tons of soil per acre per annum, equivalent to a depth of 7 inches in 25 years; and that in places, where there were steep slopes or extremely erodible soil, the loss might be 200 tons per acre per annum or a depth of 7 inches in every 5 years of cultivation. In Nyasaland Hornby computed in 1930 and 1934 that much of the highland area was losing soil at the rate of a quarter inch per annum: this soil was a comparatively shallow layer of humus over a red subsoil which readily became impervious, and so conditions favoured erosion.[2]

INFLUENCE OF FORESTS ON CLIMATE.

22. The resolution appointing the Committee mentioned that there was reason to believe West Bengal as a whole to be becoming more and more liable to flood and to drought owing to the destruction of the forests: and it is necessary therefore to make some remarks on the questions of the effects of forest on climate and on floods. There is a general belief that the climate of a country is influenced by the existence of forests and there are many who hold that the forests have a direct effect upon the rainfall. For these beliefs there is no proof; and unless statistics are gathered, over a very wide area and for a very long period, regarding forest-conditions and regarding meteorological data, no proof can be obtained. It would be useless to quote the various facts, interesting though they are, that have been thought to indicate a relation between deforestation and diminution of rain: even, if they are correct, they prove nothing because any decrease in rain

[1]Technical Communication No. 36, page 100.
[2]Technical Communication No. 36, page 109.

may have been due to a "dry cycle". It is preferable to quote the conclusions reached by two Committees which recently have dealt with the problem in South Africa.

23. The first of these was the Drought Commission appointed in 1922 which pointed out that "available meteorological data were insufficient to prove the existence of a definite recent climatic change, but that soil erosion alone would account for the drying-up of rivers and water-holes, the falling of the water-table, and the increasing disastrous effect of droughts and heavy rains, which had given rise to the belief in a climatic change." The second was the special Committee on "Forests in relation to Climate, Water Conservation and Erosion" appointed at the Fourth British Empire Forestry Conference held in South Africa in 1935. This Committee went into the question in some detail, and reached the following conclusions[1]:—

(*a*) *Temperature.*—The processes attendant upon plant growth (transpiration attended by evaporation) reduce the temperature of the air. The substance of living plants cannot become heated to the same extent as bare rock or soil: and the ground under them cannot become greatly heated by the sun's rays because these are intercepted by the canopy of vegetation. Thus forests during the growing season lower the temperature of the air in and above them, lower the temperature of the soil and correspondingly reduce evaporation. They also as a general rule modify the extremes of cold in winter. It is from the extremes of heat and cold that the most serious damage occurs, and so it is patent that the effects of forests upon the temperature of a region are highly beneficial.

(*b*) *Wind.*—By diminishing the velocity of winds, forests decrease evaporation and wind erosion. It cannot be said that they exert any great or general effect upon the broad continental air-currents except in so far as they enrich them with moisture: but locally they do exercise a very beneficial effect by obstructing the force of the wind: the use made of forests and even of mere patches of woodland or shelter-belts for the protection of buildings and lands is universally known. It is therefore unnecessary to do more than state the fact that the influence of forests in modifying the adverse effect of winds is wholly beneficial.

(*c*) *Rainfall.*—A careful review of the data available led to the opinion that at various times and in different countries altogether too much credence has been placed in the supposed influence of forests in increasing the total rainfall of a country, and that topographical features exercise a far greater influence upon precipitation than can be exerted by forests alone however vast. "On the other hand," they concluded, "there is evidence to show that forests have some influence upon the local distribution of rainfall, by lowering the temperature of moisture-laden winds and in other ways, and we affirm that from this point of view a judicious distribution of forests throughout a country is highly beneficial."

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[1]British Empire Forestry Conference, pages 3, 4 and 5.

(*d*) *Atmospheric humidity.*—"Under a leaty canopy the humidity of the air is higher in the forest than in the open. The process of transpiration of itself increases the moisture-content of the air within and near the forest; also the temperature of the air within the forest is lower and consequently nearer saturation point."

(*e*) *Evaporation.*—"Experiments extending over a great many years have demonstrated that the evaporation from soils within the forest is less than in the open. The greater the wind, the higher the temperature and the lower the humidity, the greater must be the evaporation from the soil; consequently the forest, by reducing the velocity of winds, by reducing the temperature and by increasing the relative humidity, necessarily retards evaporation. Experiments have also shown that the evaporation from free water surfaces is less within the forests than in the open. The same factors which operate to reduce evaporation from forest soils also operate to retard evaporation from free water surfaces within the forest. Within the forest, the extent of evaporation from the soil varies with the character of the vegetation and particularly with the nature of the ground litter. Some trees intercept the sun's rays much more effectively than do others. Whatever the degree of effectiveness of various tree species in this direction, however, all forests tend to retard evaporation from the surface layers of the soil."

(*f*) *General.*—"Climate, being a combination of all the above factors, has without doubt seriously deteriorated over large portions of the earth by reason of the destruction of the forests. While afforestation may have only a slight bearing on the climatic conditions of a country, the progressive destruction and degradation of vast areas of natural forest result in increasing aridity, the dessication of the soil and the impoverishment of mankind."

These conclusions of the Special Committee may be accepted. They enable an answer to be given to the question whether the West Bengal forests affect the climate of the whole Burdwan Division. It is most unlikely that they should do so. First their area, about 1,000 square miles at the most, is not very large when they are considered as a means of influencing climate. Whether in combination with the extensive forests of Chota Nagpur they might do so is another matter. Secondly, they are not distributed throughout the division: they are grouped along its western border, and it is not probable that their effect upon local distribution of rainfall would be so wide as to influence it throughout the 13,700 square miles of the Burdwan Division. The possibility that even their total disappearance would increase the chances of drought in Western Bengal as a whole may be left out of consideration when the policy as regards forest conservation is under discussion: it is probable however that they do modify to some extent the climatic conditions in their immediate neighbourhood and that they do help to control floods which exert their effects at a considerable distance from the forest areas.

24. It seems to be certain that forests influence floods. The position is summed up in the following conclusions reached by Zon in 1926[1] after examining 1,100 publications on the subject:—

(1) The total discharge of large rivers is practically independent of forest cover;

(2) Forest cover distributes and equalizes stream flow, but has little influence on large floods; and

(3) In mountainous country forests increase underground storage and seepage, and conserve water for streamflow; in level country they aid drainage.

In a publication of the United States Service and Weather Bureau, Bates and Henry describe a study of run-off from two mountain water-sheds of 200 acres each over a period of 15 years: both water-sheds were studied in their natural condition for half the time and then one was denuded of its vegetation: the soil was absorptive, the annual precipitation (rain and snow) was only 26 inches, and the run-off was therefore light. Their conclusions were as follows:—

(1) Denudation increased run-off by 15 per cent. and flood flows by 58 per cent.

(2) Denudation increased erosion eight and one-half times.

(3) Denudation increased the ratio of high to low stages or vertical fluctuation of extreme high water to extreme low water from 12·1 to 17·1.

The floods in the Tennessee Valley are an outstanding illustration of the effects which are caused by the destruction of forest in the hilly country: they have forced the United States Government to take up some of the most expensive river-control works ever erected, and it is noteworthy that some of these have professedly been designed to function only as temporary checks until reforestation makes the control permanent.[2] In Canada, according to Mr. Finlayson, the Canadian representative at the British Empire Forestry Conference of 1935, interference with forest has led to an appreciable disturbance of stream-flow: and he mentions in this connection, as a "tremendous change" the very serious floods on the Grand River in Ontario which "very frequently, perhaps once in three years," damage the towns and cities at various points on the river system.[3] In British Columbia a faster run-off from the water-sheds is becoming evident where forests have been cut down or burnt, and it is feared that this may eventually lead to disastrous flooding in low-lying districts.[4] In a paper read to the Conference Galbraith, the Chairman of the Forest Commission of Victoria, Australia, referred to the intermittent and irregular flow of the Murray River and its tributaries and the necessity for exploiting every available means of conserving the water-supply. "During the month of July 1900 more than 19,000 million cubic feet of water passed the gauging station at Forbes on the Lachlan river, yet for the whole twelve months of 1902 only 1,000 million cubic feet flowed

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[1]Quoted in "Soil Erosion and its Control" by Q. C. Ayres.
[2]Technical Communication No. 36, page 151.
[3]British Empire Forestry Conference, page 25.
[4]Technical Communication No. 36, page 188.

down the river, which for the most of the year was a succession of water-holes. Similarly at Wilcannia on the Darling River, 717,000 million cubic feet were registered in 1890, and in 1902, a year when the river ceased to flow, only 709 million cubic feet.....There seems little doubt that the primary source of all these troubles lies in the highland country forming the water-sheds of the streams and consequently the application of stricter management methods in these critical portions of catchments must be the basic consideration in formulating a policy designed to control stream flow and to conserve water-supplies." In Palestine, disastrous floods in 1933 and 1934 drew attention to the effect of destruction of scrub cover on the steep Tiberias slope above the Sea of Galilee; and considerable losses have been caused by floods due to similar causes in the steep rocky land south of Nazareth. In Syria spectacular floods, which caused numerous deaths and great loss of property, were ascribed to "the disgracefully bare condition of the Eastern slopes of the anti-Lebanon mountains.[1] In Java catastrophic erosion which followed the cutting of forest in 1917 and 1918 was accompanied by floods which caused destruction of bridges.[2] In Japan one reason for undertaking the revegetation of eroded slopes was the hope of protecting cultivated lands against floods which followed deforestation.[3] In Trinidad "with the removal of forest cover.....damage has been caused by the drying-out and erosion of the soils by shortage of water in the springs and streams during periods of fair weather and by extensive floods during periods of heavy rainfall. The very severe floods which have occurred..... .....must be largely attributed to the rapid and unchecked flow of waters down the denuded hill sides of the Northern Range."[4] In India, the Stephenson Committee remarked that denudation (destruction of forests) increased, if it was not entirely responsible for, the tendency of Chota Nagpur rivers and streams to dry up in the hot weather and to come down in freshets during the rains and said "It has been established beyond question that it is dangerous to denude the catchment areas of big rivers, especially when those areas are in hilly countries." They concluded that with the increase in deforestation the danger limit in this respect had been reached in Chota Nagpur.

25. The general effect of deforestation of catchment areas is quite clear. When rain falls, it runs off quickly carrying with it an appreciable amount of soil in suspension, instead of running off slowly after being held up by tree growth. In consequence instead of having the rivers full and more or less at one level throughout the rainy season, we have as it were a sudden wave of flood after each rain storm, alternating with a comparative lack of water in the river beds. The equilibrium of the whole river system is upset when the forests in the catchment area are destroyed: and the extent of the damage depends upon the proportion of the area over which the forests disappear. The portion of the catchment area of the Western Bengal rivers that lies inside the forest area of Western Bengal is not large in proportion to the whole: and it is impossible to say that the preservation of the forests in West Bengal and the re-afforestation of denuded areas would restore the rivers to their proper state. It, would, however, restore

[1]Technical Communication No. 36, page 19.
[2]Technical Communication No. 36, page 50.
[3]Technical Communication No. 36, page 63.
[4]Technical Communication No. 36, page 197.

some of the rivers and would tend to control local floods on some of them. The deterioration of the larger rivers of Western Bengal, such as the Ajai, the Damodar and the Kasai, is due mainly to the deterioration of forests not in Bengal but in Chota Nagpur; but this is not a reason for inaction in Bengal.

PREVENTIVE MEASURES IN OTHER COUNTRIES.

26. It is convenient at this stage to make some remarks on the measures adopted in other countries to prevent and to remedy erosion. One method is to embark on expensive methods of reclamation. The notable examples of this are in the United States of America where hundreds of millions of dollars have been and are being spent on reafforestation, on engineering works for the control of floods in rivers, and on the reclamation of agricultural land by terracing, contour-ridging, draining, gully-control and the construction of diversion ditches, dams for storing water and channels for spreading it. Such measures are far too costly to be practicable in Bengal though something may perhaps be done, if the results of experiment on the lines to be recommended later in this report prove favourable, by way of reafforestation of denuded areas. Most countries have followed the alternative method of attempting to stop erosion by discouraging practices which lead to erosion. The easiest way of doing this is for the state to own the forests; and in the United States of America steps are being taken, as is shown in Appendix XI, to acquire 359 million acres of forest land in order to ensure its proper management. In most other countries the object is to make private owners manage forest land in a manner least likely to affect public interests. The most highly developed systems on these lines are found in European countries where the forests are so small (in comparison with those of America, Africa or India) that the necessity for their conservation became apparent at an early date. Details of the legislative measures adopted in different European countries will be found in Appendix XI: it is not necessary for our present purposes to discuss them. But two features are of importance: first, there has been a growing tendency to enforce more and more control over the operations of private owners as experience has proved that otherwise forests are invariably exploited to excess for the immediate profit: and, secondly, there is decentralisation of control only in those countries, noticeably the Scandinavian countries, where the people are highly educated and where there is a general realisation of the benefits which properly managed forests bring to a country. In such countries the control over forest owners is left largely to local committees: but, where the general public are not keenly alive to the value of forests, it is usual for the Central Government of the country to retain the control in their own hands. Even in European countries a noticeable feature of forest-legislation is provision for controlling and modifying private rights, among which may be mentioned particularly grazing-rights. In other parts of the world the question of the influence on erosion of grazing has assumed extraordinary prominence. It has been found in almost all African countries that grazing in forests does immeasurable harm: and it has been found in almost all African countries, in the United States of America, in Canada, and in Australia that uncontrolled grazing even outside the forests leads to disappearance of the vegetable cover from the soil, to consolidation of the surface,

which prevents absorption of rain water, and so to erosion. This is of great interest to Bengal because there can be no doubt that grazing does much harm in the Western Bengal forests, and the fact that control is found necessary elsewhere is very relevant. Many of the control measures taken in the African countries are of no relevance to our inquiry, because they are connected with different systems of cultivation which entail damage to forests and lead to erosion. In other parts of India (including those north of Bengal) these find a parallel in the practice of *jhuming* or shifting cultivation, which involves systematic destruction of forest growth: even in Chota Nagpur the Stephenson Committee found such practices in 1908: but as will be mentioned later, forest is not now being destroyed in the Western Bengal forests for the purposes of cultivation, because there is little suitable land left and because forest-owners make a larger income from forest than they do from the letting out of very inferior land to cultivators.

PART II.

DEFORESTATION IN WESTERN BENGAL.

THE EFFECTS OF FORESTS.

27. It will be easier to understand how far similar damage is being done in the districts of West Bengal if a brief explanation is given first of the manner in which the forests control the effects of the rainfall and conserve the soil. A general description of the country covered by our inquiries, including a note on its geology, will be found in Appendix IV; but the factors which are of importance for our immediate purposes are the following. Above the practically impervious and more or less undulating rock, there is a layer of sub-soil which may be several feet thick: this is formed usually of the decomposed rock, it is not very pervious and when eroded it disintegrates into sand; only a few roots of the *sal* trees, which constitute the most important part of the West Bengal forests, penetrate into it, for anchorage. Above the sub-soil is a comparatively shallow layer of surface soil, in which almost all of the roots of the *sal* tree live: when eroded this surface soil forms silt: and, if it is too scant, the *sal* tree cannot grow on it. This surface soil carries in any forest that is not deteriorating a thin protective covering of grass, dead leaves and humus. Further protection is afforded by the canopy formed by the branches, twigs and leaves of shrubs and trees. In such a forest, the force of the rain is broken, as it falls, by the canopy of leaves, and its impact on the ground is deadened by the protective covering: instead of cutting into the ground, the rain is to a great extent absorbed by the surface soil which is made permeable by the roots of the shrubs and trees. When the surface soil becomes saturated, the water starts running off: it is obstructed by the grass and by the stems and roots of the shrubs and trees; and the rate of its flow is reduced so that much erosion does not take place. Where there is grass only, not shielded by a canopy of leaves, the rate at which the water flows off may actually be increased because the grass acts like thatch and sheds it quickly: but, precisely because the grass acts like thatch, the ground is protected from erosion. Where therefore there are unspoilt forests, there is less tendency to sudden flood: the soil holds up the water as if in a reservoir and the forest-growth checks the run off. And where there are unspoilt forests the soil serves as a reservoir not only to check sudden floods but also to store water against the dry season. The rain-water is held up on slopes by the forest-soil long enough to penetrate into the comparatively impervious subsoil and thence into the cracks and crevices of the underlying rock. Where there are such forests, the water table is higher; there are more springs; and springs, streams and rivers tend to have a more constant flow throughout the year: not only is drinking water more plentiful (a matter of great importance in the parched areas in West Bengal where the forests are situated) but the atmosphere is more humid and the tendency of the fields to become excessively dry is reduced. If forests are to be worked for profit and if they have to be worked under a clear-felling system (as is usual in Western Bengal), the canopy of leaves must at intervals

be destroyed; but it should be restored with all possible speed, while the protective covering of the soil and the actual subsoil should at all times be preserved with the utmost care. The forest soil is the fixed capital of the forest owner: he can increase it by conserving his forests and by managing them wisely, for the tree roots add to it by piercing and dissolving the sub-soil and the fallen leaves rot away into humus which enriches it: but these processes take many years before their effect is appreciable. To lose forest capital is easy. The shorter the rotation (that is, the more frequently the trees are felled), the longer the time during which in a given period the soil is exposed to the direct action of the rain: the greatest damage naturally is done during the first burst of the rains of the year in which all the trees have been cut; and the less frequently the soil suffers in this way the less the erosion. In the Dacca forests with a 25-year rotation, the soil is thus endangered one year in 25: in Western Bengal (where the soil is far shallower and far more friable) the proportion is very often 1 in 4, frequently 1 in 3, and sometimes 1 in 2. It is not strange that it has in many places disappeared. Again, the shorter the rotation, the shorter the period during which the soil is built up under the shelter of a canopy of foliage and during which the essential supplies of nitrogen are manufactured by bacterial action in the decomposing litter.

THE DESTRUCTION OF FORESTS AND ITS RESULTS.

28. The first step towards destruction of the surface soil in a forest is to allow gaps to occur in the protective canopy of leaves. This may happen in many ways. Trees which die off, or *sal* trees too old to coppice which are felled, are not replaced by seedlings: and *sal* trees young enough to coppice are felled but the coppice is prevented from growing thickly, because cattle are let in to graze too soon, because the forest is burnt at the wrong time or because shoots and leaves are cut off the trees for sale or for fuel. Where there are gaps in the canopy the rain beats violently on the ground and pits it. Where the trees are thin the grazing cattle which wander among them trample down the soil which is moreover exposed to the sun and baked hard. The rain-water runs off quickly over the hard soil and quickly cuts away the humus which it carries off into streams or into the fields near the forest. If the land slopes steeply erosion will be amazingly rapid: it will be even more rapid where the surface soil has been cut up by wheel tracks or frequented paths or where charcoal burners have dug up the stumps of trees. Where there has been a fire, that part of the protective covering which was composed of dead leaves twigs or grass is carried away immediately in the form of ashes; and if the fire has been severe part of the humus also disappears in this manner. Erosion at the outset is "sheet erosion"; that is, the water cuts into the soil from the top; particles of soil are removed, more or less uniformly, from large surfaces and at first glance it does not appear that there has been any erosion at all. More spectacular, but perhaps really less destructive, is the "gully erosion" which tends to be associated with sheet erosion to a gradually increasing extent. Gully erosion means roughly speaking that the water attacks the soil from the side, forming channels which cut back into slopes until in extreme cases they carve them into ravine lands. The first effect of sheet erosion is to hasten the process to which it owed its own

beginning: as the surface soil grows less the trees find less nutriment and die off, being replaced for a time to some extent by more hardy species, less valuable and giving less protection to the soil. At the outset the cultivators of land round the forest welcome erosion because their fields are enriched by silt and nitrates from the decomposed forest litter: but it is not long before they cease to get silt and begin to get sand instead, as the erosion begins to eat into the sub-soil. The Committee have collected no figures as to the extent of damage thus done: but an indication of its possibilities was given by the fact that near Jhargram the villagers had gone to immense pains to erect hundreds of yards of substantial embankments to protect their fields from the sand carried out of the forest, and this was a forest in comparatively good condition. The Stephenson Committee drew particular attention to this aspect of erosion, which they "noticed at the foot of the Ranchi hills, in Manbhum, and in a striking manner round the Maharparbat hill in the Banki Subdivision of Cuttack where 60 acres had been put out of cultivation in a comparatively short time." Sand is not only washed directly into the fields from the forests: it is also carried down by streams and rivers and deposited by them on fields miles distant: the most striking examples of this in West Bengal are to be found along the Damodar river where vast areas have been lost to cultivation owing to the deposit of sand carried down from Chota Nagpur. In addition this sand is dropped in the rivers, especially where they enter the plains: this is one of the reasons why they are no longer navigable for any distance: the other is that they have in a manner ceased to be rivers and have become torrents. This is a feature on which emphasis is laid in paragraph 6 of Mr. Robertson's Settlement Report for Bankura (1917-1924): "these rivers", he says, "are little more than hill streams and, except in the rains, contain only a trickle of water. After heavy rains, however, they become formidable torrents, the water rising with extraordinary rapidity in a few hours. The volume of water which rushes down at such times is enormous and in heavy flood it is dangerous and often impossible to cross the river in a ferry boat. In the rains it is no uncommon sight to see long lines of bullock-carts drawn up on the bank of the river waiting for the flood to subside. The waters subside almost as quickly as they rise." Rai Sahib R. N. Mukherjee, an old resident of Bankura, told Mr. Shebbeare, Conservator of Forests, in 1925 that streams had within his memory been perennial which were then torrents in the rains and dry for the rest of the year. The drying up of wells is another aspect of the same thing: whether this has happened to any great extent in West Bengal it is impossible to say with assurance, but it was impossible also not to be impressed with the frequency with which people complained to the Committee that the wells now dry up more quickly than they used to. There is yet another result from the erosion in country like that found in Midnapore and Bankura. When denudation is complete the exposed rock radiates such heat in the hot weather that moisture is rapidly evaporated from the neighbouring fields: this was a symptom of decay that much impressed the Stephenson Committee, and it is to be seen in the north-west of Bankura district. But it is unnecessary to say more about the pernicious effects of erosion consequent upon deforestation. The important point to remember is that where there are thick forests something like 90 per cent. of the rainfall may be retained in the soil and 10 per cent. may run off; but where there is no forest (and the land is not under crops) as little as 20 or even 10 per cent. of the rainfall may thus be retained and 80 or 90 per cent. may rush off. If

floods were to be avoided the rivers would have to enlarge their beds: but actually their beds become choked with sand.

THE NEEDS OF THE SAL TREE.

29. The tree which is of paramount importance in the West Bengal forests is the *sal*. There are, of course, many other trees in them: a list of these is reproduced, from the 1937 report of Mr. Nath, in Appendix III: but none of these is at once quick growing and as valuable as the *sal* except *peasal*: and the percentage of *peasal* is too small to be of practical importance. It is a tragedy that the *Mohwa* tree should have been so largely destroyed, but it is useless to propose that reliance should be placed on it for the replenishment of forests: and the Kendu tree, valued beyond its deserts for its fruit (and, when well grown, for its timber) is a slow grower and brings in far less, in the aggregate, than the *sal* trees which might be grown in its place. Mr. Nath estimated that the coppice forest of Western Bengal contained 95 per cent. of *sal* but this is true only of the best of such coppices: in the ordinary degenerate forest the percentage of other species is far higher and in some places they have no *sal* among them. The extent to which such other species occur may (except at the last stage of all) be taken as a rough and ready index of the extent to which the forest has been destroyed and the surface soil been carried away by sheet erosion: and the practical problem is to conserve and to increase the proportion of *sal* trees in the forests. One of the chief difficulties is the widespread belief that it is almost impossible to kill *sal* by maltreatment—a belief shared by Mr. Robertson Settlement Officer in Bankura who says in paragraph 5 of his Report—

> "the vitality of *sal* is indeed amazing. It is capable of resisting the worst possible treatment and not only of surviving but also of flourishing."

It is obvious however to anyone who visits the forests under the guidance of an expert forest officer that the belief is not true. It is with the *sal* forests as it is with the rivers of deltaic Bengal: for years maltreatment has no obvious effect upon them, and then, suddenly, a time comes when they decay and disappear with amazing speed. This is largely due to the shallowness of the surface soil and the ease with which it erodes; but another cause is the weakening of the *sal* trees themselves. If these are cut too often or stripped of their leaves, if they are grazed upon when young or exposed to fire before they have developed a resistant bark, they are bound sooner or later to disappear. Usually two processes are to be seen at work simultaneously, and it is difficult to say which is the more deadly. One goes on inside the forest, where unregulated felling and failure to replace trees lead to a general reduction of density; the evidence of this is the appearance among the trees of open patches which gradually develop into glades and in which erosion soon begins. The other process attacks the forest on its outskirts and leads to its gradual retreat: it amounts to no more than the removal of shoots and leaves and the grazing of the village cattle, but it causes a few feet or a few yards to be lost to the forest every few years: and the cumulative effect of it is fatal. The surface soil disappears imperceptibly as the forest recedes: and the usual evidence of the

completion of this process is the occurrence of sparse *kendu* shoots or, in Bankura especially, of *palash* trees on *danga* land which looks as if other vegetation had never grown upon it. But whichever process may have been at work, the ultimate cause is the same: the *sal* trees have died because they were not given a sufficient opportunity to manufacture nutriment for themselves. It is most important that all who are concerned with forest policy should have a clear idea of the manner in which a tree manufactures its nutriment, because this determines the conditions under which alone it can grow and dictates the methods in which *sal* forest should be managed. The essential point is that, if the *sal* tree is not allowed to grow, and to retain, sufficient leaves, it cannot manufacture enough food for itself and starves. Every tree gets its raw materials from two sources; from the soil it gets water with some mineral salts which it absorbs as "raw sap" through its roots; and from the air it takes in carbon dioxide through the numerous minute pores or "stomata" which cover its leaves. The tree converts these raw materials into food, "elaborated sap," in its leaves under the action of sunlight (by "photosynthesis"); and this elaborated sap is transferred to the growing points in the stem and branches and to the roots where it is utilised at once for vegetative growth or stored for use in the future. If insufficient sunlight falls on the leaves or if there are insufficient leaves to utilise the sunlight, the leaves fail to manufacture enough food for the needs of the tree: and then the vitality of the tree suffers and its vegetative growth or its production of seed is affected. Obviously, to a forest owner it is all important that this should not happen: for it means that he has less to sell and that he has less chance of replacing trees that have been cut or that have died. *Sal* trees are replaced by two methods, by coppicing and from seed. When they are cut young, coppice shoots are thrown out by the stump or "stool": as they grow older the capacity to coppice decreases and eventually is lost: and, as the tree loses its capacity to coppice, it develops the capacity to produce seed. A tree cannot continue to coppice indefinitely: after repeated cuttings the rootstock becomes incapable of producing vigorous shoots and eventually it dies: so ultimately the continuance of a forest depends on regeneration from seed. It may be said that in every forest a proportion of the trees die each year: and therefore provision must be made for their replacement from seed. For this reason a number of *sal* trees must be left at regular intervals in each forest, up to an age of 25 or 30 years, so that there may be a supply of seed. In nurseries, under favourable conditions, a *sal* seedling will grow directly into a tree. In natural conditions, however, where the seedling has to struggle for existence, it has the peculiar habit of dying back each year for many years, after producing only whippy shoots: each year, if things are favourable, its leaves manufacture a little surplus food which gives added strength to the root and at last when the root system has reached a certain stage of development, it sends out a strong "carroty shoot" which does not die back at the end of each season but develops steadily into a tree. There is little chance that this will happen while trees remain standing round the seedling, for their shade prevents its leaves from obtaining sufficient light for the manufacture of the necessary elaborated sap; and, should damage be done to the whippy shoots, it may be very long before permanent shoots are produced, if indeed the seedling does not die first. Normally regeneration is obtained from coppice in Western Bengal forests, and in these it does not matter very greatly

if a large proportion of the seedlings fail to grow into trees, since sufficient only will be needed to replace the relatively few stools which die each year. But even where regeneration is by coppice, the importance of preserving a copious leaf growth can scarcely be exaggerated: for, if the vitality of the coppice is not maintained by the leaf growth, the mortality among the stools will be unreasonably high. The conclusion is that whether reproduction is by coppice or from seed the leaf growth must be jealously preserved. The young shoots and the leaves must not be exposed to the browsing of cattle or be removed for use as fuel, the leaves must not be taken for the manufacture of plates or baskets, and fire should not be set to the forest except at times when damage can be kept down to a minimum. It will be seen from later paragraphs in this report that at present damage is usually done in every one of these ways and that many changes will have to be made before the forests cease to be starved of nutriment. But it is the great merit of the *sal* tree that at almost any stage of the process of starvation it will, if given proper treatment, recover its vitality: and it is on this fact that all the constructive proposals in this report are based.

VALUE OF WESTERN BENGAL FORESTS.

30. There are no materials from which the money value of the Western Bengal forests can be estimated. The following is merely a very rough argument. The figures for despatches of firewood from Midnapore and Bankura districts are given in Appendix III to this report: they show that the average for the years 1931-32 to 1938. was 102,428 tons per annum or nearly 2,800,000 maunds. The cost of firewood in Midnapore district was said to be about Rs. 110 per 500 maunds free on rail, and it is probably much the same in Bankura: at this rate the average brought into the two districts by the sale of firewood is about Rs. 6 lakhs. This figure of Rs. 6 lakhs is conservative when the level of recent exports is considered. The exports from Birbhum and Burdwan districts are not worth taking into account. The amount of wood used in the districts where it is grown must be very considerable: but there is no means of estimating it with any accuracy. All that can be said is that it must be a great boon to the people to get firewood and timber cheap and that its sale must lead to an appreciable increase in the owners' incomes and in the earnings of labourers. These last must be very considerable. From the evidence submitted to the Committee it would seem that about two lakhs of rupees out of the Rs. 6 lakhs spent by the exporters of firewood in Midnapore and Bankura must have gone to wood-cutters, carters and other labourers: but the total for the four districts must be very much larger. In the private forests under Government management in Dacca and Mymensingh (73,528 acres only) no less than Rs. 2 lakhs were paid to labourers in 1937 for tree-cutting, carting of timber and removal by boat; and the total benefit to the labouring classes who are employed in extracting timber and firewood for the 500,000 acres of forests in Western Bengal must be very large even though an appreciable portion of the forest is worthless now and although at no time, owing to inferior soil, do they yield so much as the Dacca and Mymensingh forests in question. To people in predominantly agricultural districts like Midnapore, Bankura and Birbhum the possibility of getting work at times when they are not wanted on the fields must be

a boon. The other benefits which result from forests have already been indicated. It would be unwise to lay emphasis on the profit from the extraction of leaves for various purposes for on the improvement in the fertility of the fields owing to the deposit of silt carried by water from the forests, for both of these ought to be checked: but the importance of the forests as grazing grounds can scarcely be overestimated. The indirect benefits, maintenance of an equable water-supply and of an equable temperature, are factors which are of supreme importance but which are usually forgotten by those who resist scientific conservation. When the prevention of floods is under consideration, it must be remembered that the serious floods which do so much damage along the Damodar and other big rivers originate not in Bengal as a rule but in the uplands of Chota Nagpur. These rivers will continue to send down their floods and to destroy fertile lands by deposits of sand, so long as the uplands of Chota Nagpur are bare of forests: but this is no reason for refraining from action to preserve and restore forests in Bengal. Apart from the necessity for preventing floods on the small rivers there is the fact that unless Bengal sees to its own forests it will be useless to suggest more vigorous action to the Government of Bihar which has already at least made a beginning. An argument not without weight is that where the streams flow out of forests they carry enough water throughout the year to make it worth while to execute small irrigation schemes: these are of great benefit to areas where scarcity is not uncommon and famine occurs occasionally.

DETERIORATION OF FORESTS IN WESTERN BENGAL.

31. Of direct evidence regarding the extent to which forests have deteriorated in Western Bengal there is little on record. The only reliable statistics are those in the Settlement Reports which give the following figures for the areas under forests:—

District.	Square miles.	Years.
Midnapore	431·86	1911—17
Bankura	519·6	1917—24
Birbhum	49·0	1924—32
Burdwan (unpublished)	61·0	1927—32
Total ..	1,061·46	

Attempts have been made at various times to estimate the extent to which the forests diminished, before and after these dates, by comparison with other figures derived from different sources, such as District Gazetteers and estimates of officers: but there is no saying how far these other figures are based on anything but guess work and it is unsafe to trust them. As an indication of the danger of such comparisons it may be mentioned that estimates of this kind made in 1937 yielded a total of 1236·30 square miles for the area of the forests, although there has certainly been no increase since the settlements. It is necessary therefore to rely on indirect evidence.

32. The Stephenson Committee which was appointed in 1908 to report on the denudation of forests did not deal with the four districts

of West Bengal with which this Committee is concerned. The first systematic inquiry made into the condition of forests in them was that of Mr. E. O. Shebbeare, Conservator of Forests, in 1925, who dealt chiefly with Bankura, where he found "the forests overcut to an almost incredible extent". He remarked as a thing "obvious to any observer that the forests are receding as is shown by the thinning out of the *sal* along the edges of blocks most exposed to villages and alongside roads" and that "in many such places *sal* has entirely disappeared and only a few scattered shoots of *kend* remain to show the former extent of the forest." He added a warning that "This comparatively slow recession of the forest blocks from their outer edges is not the most serious danger however. What is far more alarming is the report by local people that the root shoots are becoming less vigorous year by year"; and, taking into account the scarcity of seed-bearing *sal* trees, he considered it probable that "unless the destruction, which has hitherto been progressive, is checked, ten or, at the outside, twenty years will see the end." In Midnapore he found better conditions but even there, he was told, the forests were deteriorating.

33. Again in 1927 Mr. Shebbeare visited Bankura and Midnapore districts: but on this occasion his report dealt only with the effects of deforestation and the measures which might be adopted to prevent or to remedy it. In the same year however there was an inquiry by Mr. C. K. Homfray, the Silviculturist, whose report gives further evidence of the deterioration in Bankura. It stated that Rev. A. E. Brown of the Wesleyan Mission who had been at Bankura for twenty three years could remember when most of the waste lands were under forest: according to him heavy cutting of *sal* trees did not start till 1914, and it had taken only 13 years to destroy all but the remnants of the bigger forests belonging to co-sharers and the large forests which were owned by the more far-seeing zemindars. Mr. Homfray expressed the opinion that "if this state of affairs goes on, in another 20 years there will be hardly an acre of forest left in the Bankura district." In 1928 Mr. J. C. Nath, Assistant Conservator of Forests, who was put on special duty for the purpose, inspected "many jungles and waste lands in the Districts of Midnapore and Bankura", and visited Birbhum and the Ausgram forests of Burdwan. He dealt chiefly with the effects of deforestation, the existence of which he assumed to be beyond the need of proof, rather than with the evidence as to its having occurred: but he expressed the opinion that Bankura district would be completely deforested in less than 100 years unless steps were taken. The Conservator of Forests, Mr. Benskin, commented that basing an estimate on data which he had collected "in exactly similar areas in the Mirzapore district where the sal forests disappeared within 50 years of the opening of the East Indian Railway" and "considering the proximity of these Bankura forests to Calcutta and their present condition.....even 50 years is a far too optimistic anticipation of their duration." In 1937 Mr. Nath again visited the districts for the purpose of drawing up schemes for conservation and afforestation: he remarks in his report regarding the former "this coppice jungle.....is intermixed in the comparatively inaccessible areas with trees of larger growth: these are mainly in the west and north-west of Midnapore district and in the south and west of Bankura district. In the remaining areas practically nothing but stunted *sal* coppice remains, all else having given way to the axe of the wood-cutter," and refers to the total

area under forest as being "in varying stages of deterioration." Another Conservator of Forests, Mr. Meiklejohn, in forwarding Mr. Nath's proposals to Government accepted as established the fact that the forests were disappearing. The cumulative effect of the opinions of all these experts cannot be dismissed as without weight: and it would be wrong to minimise their evidential value because the present state of forests in Bankura shows that the more pessimistic of their estimates are not likely to be fulfilled. It must be remembered that a great deal has been done by way of propaganda, since Mr. Shebbeare reported in 1925, to persuade forest owners of the stupidity of destroying the forests, and the recent tendency has been for the more substantial of them to preserve their forests to the best of their ability and knowledge. In spite of this the Committee saw enough during their tours to be convinced that the danger of rapid and practically complete destruction of forests, except in parts of Midnapore, is very real; and that the owners have neither knowledge enough to make the best of their forests nor, in many cases, the power to avert their destruction.

EXTENT OF DEFORESTATION AND DENUDATION IN EACH DISTRICT.

34. The general impressions of the Committee as to the extent of deforestation in each district may be summed up as follows.

35. In Midnapore things are not nearly so bad as might have been expected, because most of the forest is in the hands of large zamindars who realise that it brings them in more than paddy land. Probably the best were the forests of the Jhargram zamindar where the rotation has for years past been a long one: there are some signs that they are becoming less dense on their edges owing to unauthorised cutting and grazing and in places the ground could with advantage carry more trees; but there seemed to be no danger of actual loss of density inside them. The Nayabasan forests of the Mayurbhanj Raj were for the most part good, but there was far too large a proportion in the portions which we saw where great damage had been done by over felling and by overgrazing. The estate is trying to introduce better methods but the people insist on practices which would certainly defeat them. These forests are in the west and south-west of the district: but in the same area the smaller forests belonging to patnidars which we saw were without exception in a bad state, with bare patches in the interior owing to too much cutting and with pronounced symptoms on their edges of excessive grazing. Along the roads in the Jhargram area the District Board has forests which are in a terrible condition, clearly neglected and regarded as fair game by every one. In the north-west corner of the Jhargram subdivision there is still a good deal of tree-forest in the less accessible areas: but the crests and upper slopes of steep hills have been denuded and eroded owing to indiscriminate cutting and there seems to have been too frequent felling lower down. In the valleys the forests are thinning out and are also shrinking as a result of grazing and local cutting: and near the road there is bad gully erosion. Not far distant, on the east side of the Cossye river the forests are in a much better state. Both the Lalgarh and the Ramgarh zemindars are looking after their forests (although both would have more success if they had experts to advise

them), and neither the loss of density nor the marginal loss of forest appears bad. The former is trying to prevent damage from stray cattle by leaving uncut the trees near the roads, and the latter has made a very interesting arrangement as regards tenants' rights, to which reference will be made later. Near their forests, along the road to Midnapore, there is a good deal where damage from overcutting and from the inroads of grazing cattle has gone very far, though not beyond remedying, to judge by what we saw elsewhere. Due north of Midnapore on the road to Amlagora there is a lot of patnidars' forest which is in a miserable condition and where both the destructive processes have been busy. Finally the Midnapore Zemindari Company are managing their forests (nearly 280 square miles in extent) on common-sense lines which give fairly good results: these would be better if the Company had expert advice and had also powers such as the Forest Department possesses to deal with petty forest offences, but the general position, except in places, is not unsatisfactory. On the whole the conclusion regarding Midnapore district is that unless Government take action the forests of the patnidars and small zamindars will disappear; while those of the larger zamindars could be made more profitable and more beneficial to the neighbourhood if Government arranged for expert advice and a certain amount of control: it may be said that the main lines of the measures proposed in this report were sketched out during our visit to this district. It was here that we came to the conclusion as to the advisability of leaving improvement largely to the forest owners, instead of entrusting it exclusively to the Forest Department as had previously been suggested as the only remedy likely to be effective.

36. In Burdwan, the next district visited, the Committee had time only for a brief inspection along the Kanksa Ilambazar road: and they merely saw the edge of the forests along the Grand Trunk Road as they passed in motor-cars. Among those along the Ilambazar road there was little marginal damage (because there are not many cattle to graze down the young shoots) but their condition generally is deplorable: there is pronounced loss of density and heavy erosion both sheet and gully. Along the Grand Trunk road there is a large proportion of very scant forest, open and heavily grazed at the edges; there is much that can scarcely be called forest any longer; and there is widespread and far-advanced erosion. From what the Committee saw and from the evidence it would seem that the condition of forests generally in Burdwan is bad.

37. In Birbhum it looks as if the forests and their owners had lost heart. The forests which the Committee saw were in a miserable condition and those which they did not see were said to be in much the same state. On both sides of the Suri-Rajnagar road the forests have been encroached upon heavily and they are very thin. They are owned for the most part by co-sharers who have to all appearances committed every mistake of management likely to cause damage to them, and they have suffered further damage owing to the unrestrained exercise of their rights by villagers. In particular the trees have been systematically robbed of all their leaves except the crown by the operation known as "Talipala", the effect of which is to make the forest look from a slight distance like Kentish hopfields. In this way the trees have lost their vitality: and there has in addition been almost unrestricted grazing. The small co-owners' forests it will be difficult to save: but it would be easy to restore to excellence such forests as

the Hetampur Estate forest near Rajnagar, which has suffered from mismanagement but shows few indications of damage from marginal grazing. In the south of the district the Committee visited the Chowpahari forest on the Bolpur-Ilambazar road: it is thin and has been rather heavily grazed: there are obvious signs of mismanagement, the chief of which was perhaps the large proportion of useless trees left unfelled in a recently cleared area: and it is obviously destined to deteriorate quickly if steps to check the process are not taken very soon. There was an interesting patch of *sal* near the Bolpur *dak*-bungalow said to have grown from seedlings some years ago after the destruction of a mango grove: it gives the appearance of having been grazed too heavily when the trees were young, and there has been sheet erosion. The general impression given by Birbhum is apathy: the owners seem to feel that it is not worth while to attempt to save their forests and the people that there is no object in refraining from practices which they know to be pernicious. As regards its forests Birbhum may be said to be in complete decadence.

38. In Bankura, the fourth of the districts with which the Committee were concerned, and the last that they visited on their tour on Western Bengal, it was obvious that the forebodings of the forest department officers had been justified. Much forest has recently disappeared and much is now disappearing. At Dhabani, on the road from Raniganj to Bankura town, the forests of the Maliara Estate are in a bad way, badly managed and badly over-grazed. At Gangalia, a few miles nearer to Bankura on the same road, they are poor, showing thin growth, clear indications of fairly recent recession on their edges, and an excessive intermixture of species other than *sal* and economically of little value; but inside these forests there is still a fair depth of soil and they would respond quickly if given a fair chance to recover. South of Bankura along the Taldangra road, there are sorry remnants of forests at intervals: but at Ratanpur there are still extensive forests which may be described as much the same as those at Gangalia: the people here like those at Gangalia have a pathetic belief in the adequacy of the unskilled methods of management in vogue. At Taldangra itself and along the road to Onda such forests as remain are in a bad way: there is a lot of bare *danga* land and a lot of heavy erosion, sheet and gully both: near Onda on this road there is little to show that comparatively recently there was forest. North-east from Bankura town on the Sonamukhi road, the Committee saw an interesting forest at Beliatora: though small and though not managed on really sound lines it is in fair condition, because it has the benefit of fertile soil washed down from other forest further up the slope: we lighted upon a considerable patch of unauthorised felling among immature *sal*, the handiwork of neighbouring villagers whom the owners were frankly unable to control. Perhaps two miles away, there was a specimen of similar jungle which did not enjoy similar advantages; in this many patches of trees had died out, young *sal* shoots had been grazed down in a manner which presaged failure to coppice in future and erosion had gone far: even if early measures are taken, the owners will have their work cut out to save this forest and, as things stand, they clearly have no intention of trying to do so. The forests of the Burdwan Raj east of Sonamukhi were interesting as showing that careful management alone, without a backing of scientific knowledge, cannot restore forest where deterioration has once been allowed to start. These forests were taken over by the Raj after

being mismanaged by tenure-holders for some years. They contain far too large a proportion of useless species and far too large a proportion of blank spaces; they have suffered terribly from sheet erosion; and they have practically no *sal* seedlings, which could restore the necessary density. An experiment in regeneration from seed was made here some years ago, and failed completely: in the absence of precise data no conclusions can be drawn from this fact. North-west of Bankura town, near the Sushunia hill, the Committee visited a tract where the forests are on the verge of being exterminated; sparse trees, new growth cut back at once owing to insane jealousy among co-sharers, indiscriminate grazing, heavy sheet erosion and rapidly extending gully erosion present a heart-breaking sight. It will be a difficult business and will take years to remedy conditions here. North and east of Bishnupur there is still jungle: it is in the same sort of plight as that near Taldangra but gully erosion is far more pronounced here than in any other place visited by the Committee: these were the last forests visited by them in Western Bengal and they would strike dismay into the most confirmed optimist. In no other of the four districts are the processes of forest destruction and soil denudation so calamitously rapid as in Bankura: it is not necessary to venture upon any prophesy as to the number of years before the forests disappear, but any one with eyes to see can tell that they will not be many.

39. It may be noted here that the extent of sheet erosion is judged in two ways: first there can be a comparison, made after digging, between the depth of soil actually existing in comparable places (but this may be misleading because conditions after all may not originally have been the same); and secondly the amount of erosion can be seen from the extent of the tree roots that is left exposed. Gully erosion on the other hand is self-evident. The worst examples of this seen by the Committee were near Vishnupur (15 to 20 feet deep and up to 50 feet wide); but it was bad at Dhabani on the Raniganj-Bankura road (4 feet deep and 50 or 60 wide); near the Ajoy River on the Kanksha-Ilambazar Road (10 to 15 feet deep and 4 to 6 wide); at places on the Suri-Bolpur road (6 or 7 feet deep); along the Taldangra and Onda roads (3 to 4 feet deep); along the District Board road south of Jhargram (3 or 4 feet deep); and among the hills north of Belpahari (4 feet deep, up to 50 feet wide). This last was associated with and merged into very heavy and recent denudation due to sheet erosion. Sheet erosion was to be seen almost everywhere, and there were signs of it even where it did not immediately catch the eye. At Lalgarh in Midnapore, for example, the exposure of tree roots showed 1½ to 2 feet of soil to have vanished recently; and on the fringe of the forest the surface soil was only 6 or 8 inches deep, as compared with twice that depth, and more, further in. Sheet erosion once started continues indefinitely till the sub-soil has been removed entirely and the underlying rock exposed or till an impervious stratum in the sub-soil is reached which protects that lying beneath it. The existence of such an impervious stratum explains the existence of the vast stretches of smooth-surfaced *danga* land which occur in all the four districts, and which have all been reduced to their present state by sheet erosion. Without elaborate research it would be impossible to determine what weight of soil is lost in a given period in the areas under investigation; but the losses must be very considerable indeed and may be comparable to those, already quoted, in the United States, Russia and the Punjab.

THE DANGA LANDS.

40. It must not be thought that without exception all the barren *danga* lands represent recent deforestation due to reckless working or to attempts to bring under cultivation unsuitable land. Beyond doubt a great deal of the *danga* has been in its present condition for many years and is likely to remain in it indefinitely if the impervious stratum which covers it is left undisturbed. In Midnapore district particularly there is a lot of such *danga* land which has been in its present state for years. As long ago as 1910 Mr. C. B. Gregson of the Midnapore Zemindari Company, who had been intimately connected with the district since 1873, remarked in a note which he sent to Mr. W. A. Marr, the then Collector, about the draft bill of the Stephenson Committee that "in the Midnapore district the forests or jungles have not of late years been denuded to any great extent. The district being more accessible the denudation took place earlier and was arrested sooner ..... The large parganas of Bogree and Bhunjbhum are the property of the Midnapore Zemindari Company and I can safely say contain almost as large an area of jungle to-day as they did 37 years ago." There has been no great change since then, for witnesses who were asked how long this or that *danga* land had been as it is now replied that no one could remember it otherwise. There were forests on such lands at one time but they disappeared long before the forests came to be worked for profit. There is a tendency to assume that such forests were destroyed because their owners wanted to put the land under cultivation. For example Mr. Jameson's Settlement Report of Midnapore (paragraph 13) speaks of "Stretches of absolutely barren land which it would be difficult to account for in a country otherwise heavily wooded on any other supposition than that of deliberate and complete deforestation" and the Stephenson Committee referred to the extension of cultivation as "perhaps the quickest method of destroying a forest." This has encouraged the idea that zamindars should be condemned because the forests which once covered these *danga* tracts have disappeared: but it is illogical. One of the great objects of the Permanent Settlement was to encourage the rapid bringing under cultivation of waste land, including forests (which had no special value then or long afterwards), and the clearance of forest was inevitable: and it was moreover proper, where the land was fit for cultivation, because land under cultivation gives the greater yield. There is nothing to show that there was deliberate deforestation where the soil was unlikely to bear crops for more than a few years: but there may of course have been errors of judgment. One of the witnesses examined at Ramgarh, a small cultivator, explained the process by which bits of forest land are selected for clearance with a view to cultivation: the people know the jungle well and have a good idea what spots have sufficient moisture to give a promise of being cultivable: they watch these for some years and see what they are like in years of different types of rainfall: and at last when they are confident that the chances are good they ask for settlement and clear the trees away. The spots which they choose are low spots on to which water will flow from higher up, not spots on the top of a ridge or on high flat ground which will get no water except such rain as falls directly upon it. Obviously they would not waste their labour in clearing and breaking up flat plains such as those where there is now *danga* land. It seems far more probable that the forest was cleared off this

land unintentionally, that the villagers who lived near it cut trees whenever they needed timber or firewood, and that heavy g ing prevented recovery and left the ground exposed to inevit erosion. In other words these old *danga* lands were produced by same cause as that which destroyed the Dalbhum forests visited the Committee on the borders of Jhargram: the people there ad ted that wholesale cutting and grazing had destroyed the forest took both the causes and the effect as matters of course. The existe of wide stretches of bare *danga* land does not in itself prove den tion of other forest land to be imminent. What is ominous, on other hand, is the large proportion of *danga* land in the other t districts on which there may be seen spare and sickly *kend* shoots flourishing *palash* trees (Butea frondosa), for these are evidence forest has recently disappeared and that the soil is disappearing.

HOW FORESTS ARE DAMAGED BY MISMANAGEMENT.

41. In his note of 1937 Mr. Nath expressed the opinion that chief source of injury to the forests of West Bengal was "the ins practice of clear felling on a very short rotation, 2—5 years." It w be wrong to deduce from this that, given a rotation of more tha years, there is no danger to the forests. It is the considered opi of the expert members of the Committee, Mr. Simmons and Mr. Ahm that "the minimum rotation, if the soil is to be protected, in West Bengal is from 10 to 12 years according to the quality of the soi it has already been explained in this report that a short rota exposes the soil too frequently to the rains and that erosion t follows more or less quickly according to the texture of the soil. far as they could judge from an examination of the forests and f the evidence presented, the Committee believe that only a small portion of the forests of Western Bengal are worked on a sufficie long rotation. The following statement summarises the evidence the four districts:—

District.	Number of forests.	Acres.	Rotation (years).
Midnapore	4	8,480	5
	3	182,481	6
	1	6,558	8
	1	25,600	8—10
	1	23,028	10
	1	17,058	10—14
Burdwan	1	480	3—5
	1	700	4
	4	7,368	5
	1	477	6 or 7
	1	3,442	12
Birbhum	1	180	4
	2	950	5
	1	28	6
	1	400	7
	1	1,205	8—10

District.	Number of forests.	Acres.	Rotation (years).
Bankura	1	100	1
	4	770	3
	7	2,399	3—4
	1	800	3—5
	5	2,817	4
	3	4,833	5
	2	4,531	5—6
	2	6,260	6
	1	1,806	6—15
	1	3,000	7—8
	1	1,500	8
	1	1,500	10
	1	1,000	10—12
	1	1,944	12
	1	1,000	18—20
	1	401	40

The total acreage worked on a rotation of 5 years and less was thus 29,877; the total with a rotation of over 5 and less than 10 years was 233,846; and the total with a rotation of over 10 was 49,373. If it were possible to treat these figures as representative of conditions in the whole area, it might be concluded that a relatively small proportion of the forests was being managed with complete recklessness: but the figures are not thus representative. The statistics collected are by no means the result of random sampling, and no averages drawn from them can apply to the whole of the area under investigation or to any individual district. It is interesting to compare the areas of the forests covered by the evidence and the total areas as given in the Settlement Reports, as in the following statement:—

District.	Area of forests according to Settlement Report.	Area of forests covered by the evidence.
Midnapore	276,390	263,205
Burdwan	39,040	12,467
Birbhum	31,360	2,763
Bankura	332,544	34,661
Total ..	677,334	313,096

The evidence covered a far larger proportion of the forests in Midnapore district than in the others because in Midnapore four forest-owners supplied information covering no less than 2,44,613 acres. But the difficulty about using such figures may be illustrated by the fact that the figures for forest area given in the statement above for Midnapore omit 37,490 acres belonging to a fifth owner who had not adopted any fixed rotation. If these 37,490 acres are taken into account the total present area of the Midnapore forests (300,695) would exceed that shown in the Settlement Report; and it is obvious therefore that land is classed now as forest which was not so classed at the time of the Settlement. The figures which were given in the replies to the questionaire and in oral evidence cannot in themselves be used to prove anything: they merely confirm the impressions, derived from visits to the forests, that the period of rotation is, as a rule, much too low and that in Midnapore it is not generally as low

as in the other three districts. It may be presumed, however, t
more evidence, in proportion to area, was produced regarding
better-managed forests than regarding the worse: for the for
mostly belong to big men who find it easier to present evidence t
the small men do, and there was naturally some reluctance on the p
of owners conscious of persistent mismanagement to come forward
admit the facts to a Committee. If this presumption is correct,
proportion of forest mismanaged would be much larger than
statement above would lead one to suppose. The Committee howe
have not been influenced by these figures in arriving at their be
that the rotations are much too short as a general rule: they were
the contrary persuaded by what they themselves saw in the forests.
is possible to discover what is the period of rotation by seeing how
the trees were when they were felled and how old are the trees s
standing, except in forests so small that they are not worked in
tions or "coupes". The age of a tree can be known by counting
number of the "rings" visible on the stumps: in a recently fel
area there are still stumps which have distinguishable rings, and
standing forests it is easy to cut occasional trees for the purpose. W
this has been done, it does not take long even for one ignorant
forest-work to be able to distinguish, from their general appe
ance, what are the ages of the various *sal* coppices, provided that
soil conditions are approximately the same. For example the sho
of the first year are quite different from those of three years' growt
these again are distinguishable easily from 6-year old growth:
the 6-year old is very different from 10-year old. To distinguish
of four years' growth from that of five years' is not easy and, with
felling and counting of rings, even an expert might hesitate bef
pronouncing whether a tree is fifteen or twenty years old. But th
can be no doubt about the ease with which the broad distincti
necessary for the Committee's purposes could be made. Even w
motoring at a fair speed one could see at a glance, after a few da
experience, whether the bulk of the forest was 6 years' old or less
had been left uncut for a longer period: and any forest which
not been touched for ten years attracted immediate attention by
relative excellence. The Committee have no hesitation in claim
that their view as to the prevalence of unduly short rotations
correct, though they regret inability to produce statistical proof o
for the benefit of those who have either not seen the forests or
had the instruction necessary for the understanding of what t
saw. It is worth mentioning, in this connection, that merely to le
forest uncut for long periods is not good forestry: if the ground
not properly stocked with trees, this practice leaves the soil open
erosion, especially if the forest is on a hill side. The Committee he
particulars of such a forest in Birbhum where trees have not been
for many decades and yet the soil is eroding: there is no regene
tion and no undergrowth and the forest is on a steep hill side. T
saw another forest, near Sonamukhi in Bankura, where beneath clu
of well-grown *sal* trees the soil is of little depth and erosion is visi
This forest is reported to have been in a bad state when it was ta
over by the present owners, and erosion had probably set in alrea
At that stage improvement under skilled management would h
been easy: but instead the trees were left to themselves. They w
sufficiently dense to shut off the light from the forest-floor and so
discourage the growth of seedlings, but not sufficiently dense to p
tect the soil from the effects of heavy rain: and the result has b

such loss of soil and such hardening of the surface as to make it almost impossible now for seeds to strike root. Such a forest will never recover without expert management; only a trained forester can decide whether natural regeneration is still feasible or whether it will be necessary to clear and to replant at a considerable cost; and even a trained forester would have to study conditions very carefully before he could advise the owner as to the best line of action. But even where there are no such difficulties, forest owners would profit by having technical advice. The expert knows when to fell or to cut back trees in order to admit light to seedlings below and how to do this without encouraging the excessive growth of weeds or grass which might shade the seedlings to an even worse extent than the tree-canopy had done: and he knows when it will pay to reduce the number of shoots per stool in coppice. If owners had consulted experts there would not now be so many badly stocked forests in Western Bengal. In every *sal* forest some trees inevitably die after repeated coppicing, and these can be replaced only by trees grown from seed: this can be achieved cheaply by leaving "standards" or seed-trees at intervals when the coppice is cut, but in many forests this has not been done. In such forests there have developed in consequence patches (which tend to grow in number) altogether bare of trees, and there are patches where worthless trees have replaced the valuable *sal*. Mr. Homfray in 1925 drew attention to the danger presented by the rapid growth of *palash* trees in Bankura: "it seems to me", he remarked "to be the water-hyacinth of the land and is appearing everywhere both in coppice areas and in waste lands: it is a useless tree and no good even for fuel: it is propagated by buds in the roots and, once a tree gets in, it springs up everywhere and it seems impossible to eradicate it. If allowed to get a good hold of the waste lands it will be very expensive and may be altogether impossible to eradicate it, and it may make the future re-afforestation of these lands with forest-species impossible: at the same time it is now spreading into the coppice and, by shading the young *sal*, it is destroying the same". If *palash* provided good cover for the soil, its deleterious effect on *sal* would matter only to the owner and to the people who benefit from the existence of *sal* forest: but it does not protect the soil from erosion as *sal* does. Nor for that matter do most of the other worthless species that replace *sal* in the forests. Failure to provide for regeneration by seed is therefore a serious danger to the province as being likely in the long run to lead to erosion. The *palash* of course is a tree on which lac can be propagated; but even if it is so used this is a small compensation for the loss of the surface soil, and nowadays, when the price of lac has fallen owing to the competition of artificial substitutes the use of *palash* for lac is hardly worth mentioning. Forests in which the growth is becoming sparse for this reason were seen in many parts of Bankura: and in Burdwan and Birbhum we saw none where there is regeneration from seed at all, though the owners of the Chowpahari forest said that they kept standards for this purpose. The leaving of species believed to be valuable, when an area is clear felled, is an error of a slightly different type: there is a good reason for cutting down all the trees and all the shrubs on such an area, in order that the new coppice may get a good start. As already explained, the new shoots will not grow properly unless there is plenty of sunlight on their leaves: and the shade cast by a tree has an appreciable effect on the growth of *sal* even ten or fifteen feet away. Every tree that is left means so much less

sal and unless the tree is more valuable than *sal* it is extravagan leave it. The *mohwa* and the *peasal* are such trees and it may no necessary to cut them along with the *sal*: but there are a lot of o species that are commonly left uncut and that it would pay the ow to clear away. Practically all forest owners, when they sell co to contractors or allow villagers to do clear-felling, insist that cer species should be left: and they actually are left, to judge by what Committee saw. Among these is *Kendu* (Diospyros melanoxylon, Western Bengal ebony): it is rarely that well-grown specimens found in the *sal* coppices: and there are many forests in which m able stunted specimens, never likely to give good timber (and in case *kendu* is of very slow growth) form an appreciable portion of total crop and detract greatly from its value. It was said that forest owners leave the *kendu* because of its fruit, but unless a re ence was intended to its value in time of famine the reason is witl weight: and as regards famine it is better to have valuable for where people can find remunerative work than inferior forest which a few trees bearing an inferior fruit may be found. Bankura, at Gangajalghati, it was said that miscellaneous trees deliberately left uncut when the *sal* was felled because the villa like to keep them for firewood: and thorny plants, including th creepers which damage the trees, are also left because the villa cut them later for use as fencing. Such favours towards the villa are more expensive than the forest owners realise and they are ou place when the same owners complain that urgent need of money fo them to cut down the rotation period even when they know this t injurious to the trees. The proper method of dealing with fel coupes is explained in Mr. Simmons' note which is printed as Appe VI to this Report. All trees (except the *sal* seed-trees and per *peasal* and *mohua*) should be clear-felled whatever their species may *sal* should be cut at a height 6 inches or 9 inches from the groun encourage strong coppice and all other species at a greater height to discourage it and weaken them: then as soon as possible the w area should be cleaned by fire as a means of stimulating the bud the *sal* stools, of destroying less resistant species and of preven fires later at a time when this would be more intense and so cause ha Another form of error is to allow a contractor to sell to villagers cut whatever trees they like and leave the rest. A few of the witn mentioned the practice of allowing the men who guard forests to firewood by way of remuneration: this is done only in small fo and at least one owner admitted that wholesale cutting by the gu had done appreciable damage.

INDISCRIMINATE CUTTING, BURNING AND GRAZING

42. Failure to observe a proper rotation and failure to pro for regeneration by seed are mistakes on the part of owners: but the other measures taken to destroy forests their owners are far les blame than the people living near to them. First to be mentione the indiscriminate destruction of trees by villagers either in exercise of some right that is claimed or by way of unmitigated th The Committee saw, in almost every forest that they visited, which had been cut down by thieves: the evidence for this was the stumps were in standing forest at places where selection felling not yet started and that the stumps gave evidence of haste in cutt

being jagged and too tall for successful coppicing. Elsewhere in the report (*vide* Appendix V in particular) there is a description of the proper way to fell trees, by cutting about six inches from the ground with the purpose of stimulating the buds sufficiently near the soil for the coppice shoots, which result, to make independent roots and strengthen the tree. When a tree has been cut in such a way as is certain to weaken it, the conclusion that it has been cut surreptitiously and dishonestly is irresistible: and the frequency with which the stumps of trees so cut are to be seen in the forests shows the crying need for stricter control than the owners, as a rule can give. Reckless and wasteful cutting by villagers is a thing which the Stephenson Committee considered to be of prime importance as a destructive agent: they mentioned cases in which aboriginals cut whole trees to get at honey secreted at the top, to collect fruit easily, or to obtain some branches. The present Committee saw and heard little of such practices in the districts visited by them, for the reason probably that big trees are now so few: but they heard a great deal especially in Midnapore about another practice on the part of villagers which does much damage to the forests, and which was mentioned by the Stephenson Committee as prevalent in the south of Ranchi. This is the custom of burning forest in order that ashes may be washed down from it on to the neighbouring fields: and it should be mentioned that the cultivators in parts of Midnapore have shown much ingenuity in constructing channels by which water carrying silt and ashes might be conveyed considerable distances to their fields. It is certain that this practice causes damage to the trees: the cultivators want as much ash as possible for their fields and so they burn as late as possible before the rains, to prevent much of the ash from being carried away by the wind and lost. Fires in forests at the end of the hot weather, when dead leaves and undergrowth are thoroughly dry, become intensely hot and not only damage young trees (especially young shoots) but also destroy the protective covering which prevents the soil erosion: it is of course the deliberate object of the villagers who follow this method to bring about erosion of the surface soil so that they may have silt on their fields, and their methods are only too successful. As is pointed out in paragraph 7 of Appendix VII, a light fire at an early stage is beneficial. In Bankura the Committee were told that, where the rotation was short and where dry firewood was therefore rare, the villagers set fire to the forests in the hottest months with the idea of killing a proportion of the coppice shoots which they then claim a right to remove because they have a recorded right to take dead wood. Many of the villagers who gave evidence in this district said that the fires were started wantonly by mischievous boys: but it is certain that the people could stop boys from doing this if they chose and it seems probable therefore that the people want the forest to be burnt. It was noticeable that practically no one mentioned to the Committee, as a motive for setting fire to forest, the hope of getting a crop of tender grass for the cattle to eat: yet particular attention was drawn to this in Mr. Robertson's Settlement Report which said of Bankura.

> "Cattle are a difficult problem in this district. The grazing is quite insufficient for them except in the rains, and indeed there is practically no grazing at all to be had except the paddy straw which is left in the fields after reaping. Where jungles exist they are the only grazing grounds, and not only is the jungle area becoming restricted but the thriftless

> and unscientific way in which the jungles are allowed to
> cut has made even the grazing in the jungles very spa
> so that the people have to resort to firing the scrub in or
> to force the herbage on which the cattle may feed. T
> cattle themselves are most wretched. Stunted and star
> they are not capable of doing the work both of plough
> and carting."

It is very probable that Mr. Robertson assumed the reason for burning of the forests to be the same as elsewhere; and that it was correct. Mr. Benskin, Conservator of Forests, suggested in 1928 t the cattle ate *sal* leaves rather than grass in the Bankura fore Whether this is so or not, it is certain that they do eat *sal* leaves v extensively in all the four districts, and not only in Bankura. T Committee saw evident traces of this on the outskirts of almost ev forest that they visited except those remote from villages. There be no doubt about the damage done to forests by grazing, even if t damage is not increased by the practice of burning them for the s of better grass. Mr. Homfray drew particular attention to this 1925, describing the grazing as "a serious menace," the more because it occurs chiefly in the dry season, from March to July, wh is the time when it is most likely to do damage: he explains t during this time the *sal* is putting out new *shoots* and if these grazed upon there is no growth for that season; when this happ repeatedly the roots as already explained are unable to get new stren and the stool dies. Mr. Homfray speaks as if the cattle found th own way into the forest: but undoubtedly their owners send th there. It is quite certain that the villagers deliberately and of int tion cause the cattle to graze in the parts of the forest where they do most damage and as far as possible at the time when they will most damage: their one object is to get the best grazing that they for their cattle regardless of the amount of damage which may t be caused to the forests, and so to the owners and also to themsel This object is best served if they succeed in having their cattle gr in areas recently felled, when the risk of damage through exposur greatest, when the young shoots should in every possible way encouraged and when the cattle find them most succulent. Hetampur zamindars have been compelled to allow grazing immedi ly after felling in their forests in Birbhum and in Burdwan, altho they recognise that this is very harmful. The people near the Na basan forests in Midnapore are claiming the right to graze ca without any restriction in the forests "except for 3 or 4 months a the jungle is cut." At Medinipur, on the Taldangra-Onda Road Bankura district, the people according to the settlement khatian graze cattle in the forest six months after felling, and they insist exercising the right. Where there are no rights, recorded or clain there is surreptitious grazing near roads: Dr. Bijoy Chandra Ba of Debsala in Burdwan complained of extensive illicit grazing: Sahib Niroda Prasad Mukherjee, President of Kota Union Board the same district said that along the roadside his forest was decrea in area "probably owing to excessive grazing": the manager of Valaidiha Estate in Bankura district says that "probably exces grazing" is the reason why their forest is being destroyed along edges: the zamindar of Ramgarh in Midnapore says that exces grazing (as well as theft of trees) on the edge of the forests is the rea for their decrease: and the zamindar of Lalgarh in the same dist

has been driven to refrain altogether from cutting forest anywhere near a road, because grazing makes regeneration so difficult. But it is obvious to any one who walks along the edge of a forest anywhere near a village and who uses his eyes that there is excessive grazing and that it causes the destruction of forests. The villagers themselves admit it: but their view is roughly that they have been doing it and mean to go on doing it, that there is nowhere else to graze their cattle and that the forests will last some time yet. That was openly the attitude of the people of Nayabasan. The people of Dalbhum in Bihar where the complete destruction of the forest has led to its being taken over by the Government expressed very similar views. Grazing in the forest has now been prohibited and this alone, with no other measure, has caused the *sal* to revive: it is now beginning to flourish. The people object to the prohibition of grazing but admit it to be reasonable and to have done a lot of good: none the less, if the prohibition were removed, they would graze their cattle in the forest as before, though they have seen that this caused its destruction. Several Presidents of Union Boards in Bankura spoke strongly of the harm done by grazing. The President of the Junbedi Union Board ascribes to this (and to the removal of stumps) more than anything else the steady decrease in the forest area "every year for the last twenty years": the President of the Chingari Union Board spoke of the damage done by grazing in young coppice where cattle browsed on the shoots and trampled down the forest-floor. A part-owner of a forest on the road from Bankura to Sonamukhi insisted that the Committee should stop and inspect his forest because he was so indignant (and with obvious reason) at the damage done by grazing cattle. It is clear that one of the chief reasons why grazing does so much harm in certain forests is the indeterminate nature of the rights claimed: there is in some places nothing to show how many people in a village may claim the right of grazing, how many cattle each man may graze, or within what limits the rights may be exercised: and the result is that, as they destroy the forest near the village, the people send their cattle further and further away to repeat the destructive process. Cow, goat and buffalo were all seen by the Committee to be grazing in the forests: the two former are really dangerous only to shoots and to young trees (except indirectly through the erosion that they cause), but the buffalo destroys poles and tramples down the ground to a terrible extent. It can hardly be doubted that excessive grazing is almost if not quite as great a danger to forests as a short rotation. How great a danger is shown by the speed with which forests can recover when grazing is prohibited. The Dalbhum forest was the most striking instance of this that the Committee saw. There was another instance quoted in evidence at Jhargram which must be little less remarkable: the closing to grazing of an overgrazed area inside a forest has led to "the growth of a fully stocked sapling crop." Prohibition of grazing, at least in regeneration areas, is obviously the essential step to take when a forest is in danger of destruction, and unless this can be done no other measures can possibly have any success.

OTHER HARMFUL PRACTICES.

43. There seems to be a general practice of grubbing up old stumps and burning them for charcoal. The first reference to this is

in a pamphlet of 1925 issued by Mr. J. C. French, Collector of Banku who believed that the problem of forest deterioration might be sol by propaganda: the material for the pamphlet was gathered by B Bireswar Sanyal. In 1927 Mr. Homfray said that according villagers in Bankura only dead stumps were so treated, but he thou that living stools were dug up as well. It would do a great dea harm to dig up stumps, whether living or dead, especially on slo for it gives a start to erosion and encourages the deliberate kill of the trees. It is a practice which occurs in all the districts, most of all in Bankura. At Nayabasan in Midnapore the mana said that the charcoal made from such stumps was particularly pri by blacksmiths. A rather similar practice was found to exist at place in Midnapore and at many in Bankura: this is to fell the t in such a way as to leave a stump a foot or eighteen inches h when a forest coupe is cleared and to allow charcoal burners to c later and dress the stump down to ground level or just above it. Midnapore this was done in the forest of a patnidar who believes t it results in shoots 5 or 6 feet high being produced in the first ye he causes the trees to be felled first at from 6 to 9 inches above gro level (which is about right) and then to be dressed down to gro level (which is wrong): he finds that his forest is deteriorating does not believe that it is due to his mismanagement. In Bank the practice is in vogue in the Goaldanga forest: the people there firm believers in its merits, though they admit that some of the stu die from shock and bad cutting, that any number of bare patches to be found in the forest, that stocking is worse than it was and t the soil is being washed away. At Taldangra where the practice followed, Babu Bibhuti Mukherjee, President of the Union Boa thinks that it makes the forest degenerate; at Patharmara the ten holders wink at it though the lease which they issue forbids it; at Junbedi the President (already quoted on grazing) says that causes whippy shoots and losses owing to shock. All Forest Offi agree that the shock of the second cutting, just at the time when stump has recovered from the initial shock of felling and when b begun to put out shoots, is tremendous and the inevitable result is weakening of the *sal*: and those witnesses who said that people high because it was easier were nearer the truth than those who cla ed some mysterious benefit from the process. The owners do appear so much to approve of the process as to suffer it because fo maintenance is difficult if the local people are hostile. The same rea explains why the forest owners of Birbhum tolerate the destruct of their forests by the practice of "*Talipala*" (or "*Jhorepala*" as it called in the Raipur area); they may possibly be tempted by its yie ing ready money in years when there is no clear felling, but this hardly consistent with their attitude that it is hardly worth while give attention to forests which in any case yield comparatively litt "*Talipala*" means that soon after clear felling, or (with the lar men) 2½ years after clear felling, the small branches and all the sho except one are cut off the stool: in each subsequent year the n branches and the new shoots are similarly cut and all the branc except those at the crown are lopped off the tree into which the solit shoot that has been spared has been allowed to grow. The people s that this cutting and lopping makes the solitary shoot grow m vigorously: at the same time they remark on the deterioration of t forests, for which they advance other reasons, some of them undoub ly true. From the explanation already given of the manner in wh a tree gets its strength from its leaves it will be understood that t

practice of *Talipala* is extremely weakening to the tree. The leaves and branches are sold: the former are used for making leaf cups, plates, and baskets (and there is also a good deal of theft of leaves from trees for this purpose) and the latter for burning in sugarcane furnaces or for boiling paddy before it is husked. Dead leaves which have fallen off the trees are collected and used in the same way, as fuel: they are taken away by the cartload as the Committee saw for themselves on the Birbhum roads. It was an interesting thing that this removal of dead leaves was denounced as the chief cause of the deterioration of the forests by those witnesses who had thought about the matter, even when they professed disbelief in the possibility that *Talipala* could be doing harm. The removal of fallen leaves is of course a bad thing: it prevents them from rotting and enriching the ground with humus and also from protecting the soil against erosion. In forests where the ground is exposed to the sun and to the rain as in the Birbhum forests in which *Talipala* is practised and where cattle graze freely as they do in these forests because they are so open, the need for the protective layer over the surface soil is even greater than in ordinary forest: and it is hard to find words strong enough to denounce both the practices. If the Committee had been asked to allot a prize to the district in which the people had evolved the most efficient means of destroying forest, they would on the whole have allotted it to Birbhum rather than to Bankura: for in Birbhum with its *Talipala* and persistent removal of fallen leaves the forest is given no rest at all, while in Bankura (except where there is insane jealousy among co-sharers) the destructive process is intermittent and the forest does at least have an occasional rest.

POPULAR MISCONCEPTIONS.

44. It will perhaps make it easier to understand some of the points touched upon above if the various popular misconceptions or superstitions about *sal* are discussed in one paragraph. Of superstitions proper only two came to light. One is the belief (held in Salboni, Midnapore district) that *sal* will not coppice satisfactorily unless cut after the full moon: excellent coppice from trees cut before it disproves the idea completely. The other is widely believed in Midnapore even by educated persons: it is that *sal* turns into *kendu* when the soil dries up: this is a misinterpretation of the fact that *kendu* is even more resistant than *sal*, and that when the forest has been destroyed and the last remnants of *sal* have given up the struggle some sparse shoots of *kendu* will often be found still alive on the otherwise bare *danga* land. A mistaken belief somewhat allied to this is that the starveling *sal* shoots to be seen on the edge of forest which is receding are seedlings and a sign that regeneration is active: this belief is held by many small owners and it blinds them to the fact that their forest is doomed unless their methods are changed. The truth may be seen if the roots are dug up: this shows that the shoots in question spring from the remains of stumps and are therefore relics of trees which are practically dead. The root of a *sal* seedling is quite different, even when it is fifteen or twenty years old as may happen before it sends up a carroty shoot. The theory was propounded by a patwidar in Jhargram that the vigour and the number of shoots decline if the rotation is more than seven years: this is obviously a perversion of the fact that mature *sal* trees will not coppice but regenerate only through seed.

The belief held firmly in parts of Bankura and Burdwan that cannot be grown from seed is hard to explain: at Beliator, w witnesses were positive that it would not happen, there were actu small *sal* seedlings within a few feet of them: the substratur truth to this belief is the inability of *sal* seedlings to develop into in places where the soil is too thin or too poor. In Birbhum held that lopping side branches gives tall and straight *sal* trees w grow quickly and have an even diameter throughout: the trut that being bare they look tall and of even thickness but are no so really than those which are left with their leaves intact: ce species of trees which are grown close together have few leaves ex in the crown and grow tall and straight; but the same result ca be attained in other species merely by lopping off all the bran except those in the crown. The analogous belief in the same dis that lopping off all but one shoot when a *sal* coppices is a good t because it makes that one strong, is based on a confusion: when t is a strong root all the strength of the tree will go into the one sh but the tree is weakened because the proportion of leaf is too sm there is something to be said for the practice under proper contr forests where the *sal* is grown for poles, but in those where it is g for firewood there is no excuse for it at all. The belief held Bankura village that it does not matter if a stump dies because it be revived by hacking the roots with an axe is absurd: and is that held in another village in the same district, that the bud of coppice is stimulated if the tree is felled below ground level the stump covered with earth, because under such conditions t will be no buds. Nothing more need be said about the belief th pays to cut high first and then cut again near the root: the pe it is true, showed the Committee some admirable young saplings g from stools thus treated, but they were no better than those grow the ordinary method, there appeared to be less total growth per and the general condition of the forest was very poor, with an exce proportion of *palash* and worthless thorns. In many places the pe are serenely confident that it is excessive rain which causes erosion not over-exploitation or mismanagement: but they do not pretend rain is heavier than it used to be when there was no erosion.

CAUSES OF FOREST MISMANAGEMENT BY OWNERS.

45. Control of some kind over the management of the fores inevitable if their deterioration is to be retarded or remedied; and therefore advisable to discuss the causes of their mismanagement. to the time when the railways were constructed forests had practic no money value and there was little temptation either to exploit t or to prevent their incidental destruction by cultivators. The Indian Railway line to Raniganj opened in 1855 and was extende Asansol ten years later: the Sahibganj loop line was constructed 1858 and the Ondal Sainthia line by 1907. The result of the firs these was the rapid development of the coal mines which was acc pained by the clearance of forest from much of Asansol subdivisi the second led to clearance of forest in Birbhum: and the third not seem to have had any pronounced effect on forest. The Be Nagpur Railway main line which passes through the Jhargram fo in Midnapore opened in 1898 and the branch from Kharagpur to A which serves the north of Midnapore and the greater part of Bank

in 1903. It has already been made apparent that the effect of the opening up of Bankura was the rapid wholesale destruction of forests and that in Midnapore where the railways were no less accessible the forests are still in fair condition: this contrast is most instructive. The reason for the difference will probably have been gathered already from the paragraphs discussing the management of forests: it is that in Midnapore forests are large and in Bankura, for the most part, small. The big owners could take a long view. Mr. Jameson's Midnapore Settlement Report pointed out that although railways encouraged the exploitation of forests their secondary effect was to check reckless exploitation in Midnapore: "now that the timber has become valuable," he wrote, "through the opening up of the country by railways and the possibility of finding a market for it, landlords are careful to prevent them from being uprooted altogether and to make provision for their regrowth": but he would be a bold man who made that statement of Bankura, where the many small owners could not as a rule resist the temptation to turn their forests into money quickly. The big owners such as are found in Midnapore argue that forests acre per acre bring them a bigger net return than cultivated land let out to tenants. One said that he preferred to get Re. 1 or Re. 1-4 per bigha per annum from forest rather than 2 annas per bigha (and that difficult to collect) from agricultural land. This figure of 2 annas represented the rate paid for land on the outskirts of forest which can give a crop perhaps once in three years. Another large landlord said that he would be glad to extend his forests if he could get the land, and, whenever possible, he buys up forest that is put to sale. There is little difficulty about recovery of money for forest coupes from the large contractors; it is paid down in large sums according to written contracts. This is much more convenient for the landlord than having to recover rent by expensive civil suits after several years delay from tenants who may take advantage of the Bengal Agricultural Debtors' Act, as it is being worked, to defer payment interminably. There are two factors which operate to make management by the big forest owner defective: they lack technical knowledge and facilities for getting technical advice, and they are handicapped when they deal with forest offences by lack of powers such as are given to Forest Officers in the Forest Act. But if all the forests had been managed like those of the big owners of Midnapore there would have been no occasion to appoint this Committee. It is far otherwise with the small owners alike in Midnapore and in other districts, with some few exceptions. They cannot afford to keep an adequate staff, much less to employ any skilled managers: they rely on their own common sense and on the local ideas as to forest management with regard to policy, and on a few ill paid and usually part-time guards and on their own personal authority in the neighbourhood for the protection of their forest against theft and the intrusion of cattle. The waning of this personal influence will be discussed later in this report, but that it is a fact cannot be denied. They say themselves that they realise short rotation to be a mistake (probably having learnt this much from the propaganda inaugurated by Mr. French and renewed in some degree whenever a Forest Officer has made a new inquiry as to the decay of the forests) but they add that they cannot help themselves. Economic pressure drives them to sell to contractors the right to cut their forest before the trees are fit to be felled. One witness put the matter bluntly: he knew that by his present methods he would lose his forest but he was sure if he changed them he would be sold up in a revenue sale and lose all his property including the forest: and his choice in such

a dilemma was obvious. It is not necessary to discuss why the sm zamindars and patnidars were reduced originally to this pressing ne for ready money. Their enemies say that their own extravagance to blame; but the whole social organisation tends to break up esta and the revenue system has always been cruelly hard on the small ma who is driven in years of bad harvest and non-payment of rents borrow at ruinous interest. Recently the tendency of tenants to wi hold rent because politicians promise wholesale reductions or ev abolition has made matters worse: and the owners of small fore have resigned themselves to living on them for the moment beca they, alone of their property, bring in ready cash without a law su In Bankura district witnesses alleged, apparently with truth, that drastic increase in the assessment of cess, combined with the impositi of cess on the estimated profit from forests, drove them to reduce t period of rotation: when a family budget was cut so fine that savi was impossible without a change in the whole style of living, a sudd increase in the amount of cess to be paid was a calamity, and it is wonder that such families decided to pay it by sacrificing part of t capital value of their forest. Worst of all was the plight of co-owne They usually started on the plan of reserving a portion of the for for their domestic needs and leasing the remainder to contractors intervals for clear-felling: one of them would be suspected of taki more than his fair share from the reserved portion and others rat than allow him this advantage would do the same: the result was th the trees in the reserved portion would all be cut, and then one of t co-sharers would cut firewood or poles in the other portion set asi for leasing eventually to contractors, the same scramble among the sharers which had ruined the reserved portion would thus extend the whole forest and the rotation would be shortened or abandon altogether. A good example of all this is to be seen in the Lachmanp forest near Silda in Midnapore district. Another is near Susunia Bankura district where most of the forest has already gone togeth with the surface soil and where the pathetic remnants are now cle felled every year: such an example of insane jealousy among sharers would be almost unbelievable if there were not other instanc almost as bad. Where the forests were small and the sharers num rous, as was the case at Rajnagar in Birbhum, there was no pretence working on any reasonable plan and the co-sharers merely cut as fa as they could because if any did not the others would anyhow. The was only one instance found in which co-sharers had faced the proble and to all appearances settled it: this was in Burdwan where the sharers in a big estate have formed a company with themselves shareholders for the management of their forests by one of th number: and this is not a method that can be imitated general Unless the co-sharers' forests are to be allowed to disappear so scheme for enforcing proper management is essential.

REMEDIES PREVIOUSLY SUGGESTED.

46. It will facilitate an understanding of the remedies propos by the Committee if other proposals put forward from time to time a first examined. The first was the suggestion made by the Stephens Committee in 1906 that there should be a Private Forests Bill whi would give power to Government "to intervene, in the public interes to preserve private forests from destruction, and to facilitate, or

some cases direct, the afforestation of waste land". They explained that the provision in section 37 of the Indian Forest Act which enables a forest owner to demand the acquisition by Government of forest in respect of which powers of control have been exercised under that Act made it impossible to exercise the powers freely, and they proposed that Government should be put into a position to take over control of any private forest of which the preservation could not safely be left to the persons immediately interested in the forest: a Bill on these lines was drafted and circulated in Bihar and Orissa, the province to which the forests covered by the Stephenson Report had been transferred; it was criticised as encroaching too much on the rights of private property and leaving too much to the Executive Government; and it was dropped. In 1925 another Bill was drafted in that province, which provided for the exercise of private rights in such a way as not to injure the forests, for a partition of forests between landlords and tenants into areas in which they might exercise their respective rights and for the control of forest management where it was thought necessary by Government. This Bill did not propose giving power to take over forests and aimed rather at guiding and assisting the owners in their management: but it also was dropped owing to whether it would receive support in the Legislative Council.

47. Undoubtedly the refusal of Government to adopt the proposals of the Stephenson Committee influenced the attitude of the Forest Officers who reported on the measures to be taken in Western Bengal. They suggested from time to time all sorts of alternatives before reverting at last in 1937 to the idea that compulsion was the only solution of the problem. The first of these was that there should be propaganda to persuade the persons concerned to alter their ways. In 1925 Mr. Shebbeare remarked that it was "a matter of inducing the people and the zamindars to economise in their own interests rather than of enforcing rules", though he added the suggestion that "village forests" should be put under the management of village Co-operative Societies. In this he was following the ideas of the District Magistrate of Bankura, Mr. J. C. French, who warmly advocated voluntary effort (because greater output was "a question of private rather than of public importance") through propaganda for the preservation of forests and afforestation of waste land through the agency of village Co-operative Societies, on the model of the Co-operative Irrigation Societies of which at that time greater results were expected than have since been realised. As already mentioned Mr. French caused pamphlets locally written to be distributed: and to his energy may be attributed the fact that most of the forest owners of Bankura realise their methods of management to be wrong. In 1927 Mr. Shebbeare recognised that the policy of persuading forest owners to adopt a right system of forest management was bound to fail, because the forests would have disappeared before the education of the owners could be completed: and it is certain that the propaganda has had no practical effect. The attempt to systematise it by forming a Forest Association in Bankura in January 1928 was a failure: the Association never functioned. In November of the same year, Mr. Cook, who was then Commissioner of the Burdwan Division, summed up the position trenchantly when commenting on Mr. Nath's report: he asked what a representative Committee could do that Government officers had not already done: non-officials who owned no forests would speak to much the same effect as the officials while those who had forests would whittle down the

remedies till they were not worth applying. Propaganda will undo
edly be necessary in order to win the public over to acquiescenc
the strict control of the forests: but by itself it can never be effec
As Mr. Nath pointed out in 1928, forest policy necessitates taki
long view and to inculcate long views into innumerable joint ow
of estates of all sizes especially when many are illiterate or half edu
ed would in itself be a hopeless task; but when in addition the w
population would have to be persuaded to refrain from exerci
rights, which they believe to be to their immediate advantage, in
interest of the future benefit of the general public it would obvio
be ridiculous to attempt it.

48. The idea that Co-operative Societies might manage reafforc
tion was not one obviously absurd. Mr. French proposed that w
land should be leased on a nominal rent to Societies which would p
trees and watch them to prevent damage, theft or grazing: and
there had been suitable land, if any one had taken an interes
methods of afforestation had been tested and had promised success
if Co-operative Societies were an efficient agent for managing
thing, the proposal might have worked. But as presented afterwa
as a scheme for management of existing forests, the idea was fu
for there was no reason why the owners of these forests should n
them over to Co-operative Societies. Mr. Nath suggested that as
reason for working on a short rotation was the pressing need of mo
at intervals, owners might take loans from Co-operative Banks on
security of their forests and repay them with interest out of the incr
ed profits which would result from a longer felling rotation. Th
a scheme totally different from Co-operative management and in i
would not go far to solve the problem.

49. Mr. Hart as Collector of Bankura advocated managemen
village forests by Union Boards, which would prevent petty theft
see that felling was in accordance with a plan. Even if there
village forests which could be put under the control of the Boards
no instance of such a forest was brought to the notice of the Com
tee), they would not be capable of managing them, they would
no members with a knowledge of scientific management and could
afford to pay for trained officers; they have no legal power to
such property; if they held it, they could scarcely be trusted
powers to try offences in respect of it: they would not afford contin
of management, because their members may change at each elect
and, since as it is Union Board members often neglect the work
has to be done under the Act, it would be unwise to thrust other du
upon them. So strongly did the Committee feel convinced of
impracticability of the proposal that they struck out from the d
questionnaire the questions relating to it.

50. In 1927 Mr. Symons, as Collector of Bankura, sugge
management by a Forest Improvement Trust, a whole-time body
adequate powers and finances at its disposal to carry out schemes
re-afforestation and development, to prevent the mismanagemen
important existing forests in danger of extinction, and to acquire
make over jungle lands to Union Boards or local Co-operative Socie
and to give technical advice to forest owners. In some respects
scheme is analogous to that adopted in Finland, but, apart from
fact that it has not been worked out in detail, it is open to the ob
tions that it would be almost impossible to obtain suitable mem
and that the question of finance is a serious difficulty.

51. In 1927 Mr. Shebbeare suggested that Government should acquire the waste lands of Bankura for the purpose of afforestation with *sal*. He had by this time come to see that there was no chance of persuading all the owners to manage their forests properly; and he assumed that Government would not consider any such schemes as had been suggested by the Stephenson Committee. The conditions which he himself set forth prove the impracticability of the idea: they were first that a way could be found to regenerate *sal* on such land fairly cheaply and secondly that "the land, now absolutely worthless, could be acquired at a reasonable figure". Until the first condition can be satisfied, the second cannot be: any price would be unreasonable for worthless land if there is no known way of utilising it: and there is still no way known of regenerating *sal* cheaply where there is no surface soil in the sense in which the expression has been used in this report.

52. No one has ever seriously suggested that Government should acquire the forests, but it has been proposed that they should take leases of them. The first form of this was Mr. Homfray's proposal in 1927 that Government might "lease the forest (not land) from the co-sharers of each village and pay them say a little more than they get now. He considered that this would be popular and that "the main difficulty would be the policing of the areas, as illicit cutting, grazing and extraction of roots must be prevented at all costs": but a much more real difficulty would be that it would be impossible to discover what the owners really get at present and that there would have to be some arrangement (which would inevitably cause discontent) for the compulsory fixing of rates of rent in different forests, if more than a fraction of the total forest in the four districts was to be taken on lease. The whole thing would be far too cumbrous to be workable and it assumes such unanimity among co-sharers as would rarely be found. If there were no compulsion the plan would offer no prospects of continuity: owners would not give long leases at low rates, because they all dream of the possibility of another period of high prices, such as attended the coal boom and would dislike a system which would destroy their chances of profiting by it; and the result would be that Government would nurse the forests for a time, only to have them worked to destruction again as soon as they were handed back to the owner. It might amount to making a gift of capital to the owner, without any guarantee that the public would benefit by the permanent conservation of forest: if it were sought to avoid this risk by sinking no capital in the forests the improvement in their condition would be very small where deterioration was far advanced. If there is to be compulsion, it should be such as is likely to secure the object desired. These objections do not apply quite so strongly to the suggestion made by Mr. Nath in 1928 that Government should take long-term leases "of suitable tracts of forest" on payment to the owner of a sum based on past rental obtained by him: the leases would have to be compulsory and the system could thus involve restrictions on the free use of their property by the owners which would be "justifiable on the grounds of public interest." The Conservator, Mr. Benskin, thought this "to be the most suitable way of obtaining control of the forests." But the justification for interfering with private management on the small scale suggested by Mr. Nath is extremely problematic: to save 30 or 40 thousand acres from deforestation and erosion would not be sufficient to have a very great effect on the problem as a whole and it

would be hard to show that public interests could be served by it
ciently. After all 40,000 acres are a very small proportion o
679,000 acres shown as under forest in the Settlement Reports.
would be practical difficulties as to the details of the leases an
whole system might be criticised as being a plan to secure profi
Government. The analogous system of management of private f
under agreements which has been tried in Bihar is more attra
than this one: it is discussed below.

53. The solution that Mr. Nath favoured in 1928 was "fo
owners of large estates to come forward voluntarily and apply
section 38 of the Indian Forest Act." This section provides
Government may apply any provision of the Act to a forest a
request of the owner or of "the owners of shares therein amounti
the aggregate to at least two-thirds thereof." This is not rea
solution of the problem at all: it would apply only to the f
which are being managed fairly well already and would lea
inevitable destruction all the forests where damage is really being
on an alarming scale. Further there is not the least chance tha
owners of the big forests would come forward with such applica
Mr. Nath, who himself expressed doubts on this point, thought
the owners might be reconciled to the loss of their liberty to
forests into ready money whenever they wished by the likeliho
a permanent and probably increasing revenue. He forgot that
of these forests yield a permanent revenue already and that their o
do not believe it possible to increase this under Government ma
ment even if they accept the possibility of a greater yield with scie
methods. Owners generally argue that they would lose because
Government management the overhead charges are heavy owing t
contributions made for leave and pensionary charges at approxin
27 per cent. of the pay of the staff; and they believe the actual p
be too high. It is irrelevant that better pay and prospects
better results because honesty on the part of the staff is imperat
forest management and cannot be had unless it is paid for: the
is that the forest owners are not convinced of this and think thei
staff is good enough. No great use has been made of the secti
Bengal. There have been no applications under it in Western B
and the applications in Mymensingh were due largely to the reali
that disagreements between the 42 proprietors in one case and t
in another were leading to the destruction of the forests. The ap
tion in Dacca was made by the Court of Wards and gives no indi
of what a private individual would do.

54. The objections to all the other proposals put forward
1925 onwards led Mr. Nath in his 1937 report to revert to the id
compulsion and to suggest the use of section 36 of the Indian
Act (which permits Government to assume control over forests
certain conditions) after amending section 37 in such a way as to
it no longer possible for an owner to demand acquisition of the
after three years. In this form the proposal was practically on
expropriation because it would have been open to Government to
the control of the forests indefinitely and to work them in so co
manner as to leave little profit to be paid to the owner. The S
Conservator of Forests, Mr. Meiklejohn, agreed with Mr. Nath's
as to the need for compulsion but did not support his actual prop
he recommended instead that the whole of Chapter V of the I

Forest Act should be amended. His main proposals were that Government should be given full powers to take over the control of private forests and that the owners should pay management costs and losses (if any) and should share any profit equally with Government. In essentials his proposals are open to the criticisms brought above against Mr. Nath's and they need not be discussed therefore.

THE FOREST AGREEMENTS IN CHOTA NAGPUR.

55. When the Bihar and Orissa Government decided not to legislate for the conservation of forests, they fell back upon the use of section 38 of the Indian Forest Act; and they attempted to induce owners to apply for Government management by offering agreements on extremely favourable terms. The standard form of agreement is printed as Appendix VI to this report. The important features of the arrangement are as follows:—

Preamble.—There has to be an application by the owner, and the Government must be satisfied that the taking over of the forest will tend to the public advantage.

Clause II.—Government management is for 35 or 40 years, according to the condition of the forest when it is taken over.

Clause IV.—There is an enquiry by a Forest Settlement Officer whose pay and allowances are met by Government: the owner pays for the staff, for the compensation to persons whose rights are modified and for demarcation.

Clause V.—Government appoint a Forest Officer, but ordinarily appoint one acceptable to the owner.

Clause IX.—For the first 11 or 10 years (according to the period of control) Government meet the cost of this officer: during the next 24 or 30 the owner pays at the end of every three years 12½ per cent. of the profits made during them or the actual cost calculated by the Conservator, whichever is less.

Clause VII.—Government decide what is to be spent, and manage receipts and expenditure: in each of the first 11 years and at the end of each three afterwards they pay the owner from 1 to 2 annas per year per acre on the total acreage of the forest, and, if there are any profits, after these payments have been made and management costs have been met, they are shared by Government and the owner equally.

Clause VIII.—In the first 11 or 10 years any debit balance is not carried forward from one year to the next: and in subsequent years, which are divided into three year periods, any debit balance is not carried forward beyond each third year.

56. It was pointed out in 1922 by Mr. J. A. Hubback (now Sir John Hubback) that under a system like this "the owner, though he loses his liberty to turn his forests into ready money once for all, is likely to obtain a permanent and probably increasing revenue from their products", as happened with the Porahat forests which after having a total net income of about Rs. 1,00,000 in the first fifteen years of Government management, 1891-1906, had one of about Rs. 4,50,000 in the next fifteen. He added that it was a great advantage to the owners to get a considerable portion of their forests freed from all or nearly all rights of other persons, in exchange for giving up a portion completely to them, in which they could exercise

rights freely: he remarked that it was yet to be seen whether the would abuse this position to the extent that future generations woul suffer. It is obvious that the agreement would not be attractive to th small forest owner of Bankura: the receipt of an anna, or even tw per acre would not be to him in any way a desirable substitute for th possibility of raising as many rupees, perhaps, by selling his fore if there was a sudden demand on him. Even in Bihar and Oriss the response by forest owners was not enthusiastic. In 1922 applic tions for reservation or protection of private forests (under agreemen not quite so attractive as the present one) covered a total of 303,5 acres: and it was remarked then that "with one exception all hav come from estates under management" of the Court of Wards an "there is little indication of ordinary private owners availing then selves of the opportunity of securing sound management of their fores at little cost." The acreage of the forests in different districts cover by the applications was given by him as follows:—

Applications pending in 1922.

District.	No. of estates.	Acres of forest.
Palamau	8	101,781
Manbhum	6	28,266
Ranchi	8	29,069
Hazaribagh	1	141,323
Gaya	1	3,100
Total ..	24	303,539

Mr. Hubback pointed out that this was a very small proportion of t total area under forest in the province. In March 1922, the whole ar of private forest in Chota Nagpur "brought or about to be broug under protection or reservation, including that acquired," since 19 amounted only to 490 square miles or 313,600 acres, whereas fore land of no use except for forest was recorded as being 1392 square mil or 890,880 acres in Ranchi district and 2400 square miles or 1,356,9 acres in Hazaribagh: for the other districts he did not give figur Information has not been received as to the acreage, covered by t applications above mentioned, that eventually came under Governme management. The next set of figures available relates to the yea after 1922. They show the following:—

Private forests placed under Government management, 1922-1938.

Province.	District.	No. of estates.	Acres of forest.
Orissa ..	Cuttack ..	1	4,552
Bihar	Singhbhum ..	4	144,041
	Ranchi ..	7	71,499

It is quite clear that the forest owners have continued to hold alo It is therefore useless to suggest that this system could be imitat with success in Bengal. Mr. Meiklejohn characterised it as "a part failure and a heavy financial burden" in Bihar, and it was for th reason that he strongly advised compulsory measures. The Commit are of opinion that these are absolutely necessary if deforestation a erosion are to be checked, and the following paragraph describes t type of compulsion that they consider likely to be efficacious.

Notes on the working of private forests in Bihar are given at the e of Appendix VI.

PART III.

PROPOSALS OF THE COMMITTEE.

THE DRAFT PRIVATE FORESTS BILL.

57. The proposals of the Committee have been put into the form of a draft Private Forests Bill which is annexed to this report. This procedure has certain advantages. The very process of drafting a Bill necessitates a close examination of the machinery by which it is intended to give effect to the proposals and leads to the discovery of objections and weak points: and a draft Bill enables persons interested to see at once precisely what the proposals are and how they might work. But it must be understood that the draft Bill has not been examined or passed by the Legislative Department, and its provisions might have to be recast considerably before they could satisfy the requirements of that department. It will be seen that it is proposed to have a self-contained Bill and not merely to provide machinery supplementary to or dependent upon the Indian Forest Act. The provisions of this Act have been found not to be altogether satisfactory, and the Government of Bengal are believed to be contemplating the advisability of having a special Bengal Forest Act. If in any Act passed as a result of this report references were made to the Indian Forest Act, it might be necessary to introduce an amending Bill as soon as the Bengal Forest Act became law. In addition the provisions of the Indian Forest Act appear to be not altogether convenient for use in connection with private forests: they were framed for use in Government forests and if the attempt was made to use them, as they stand, in connection with private forests there would probably be occasions when Forest Officers would be uncertain how to proceed. It will be seen however that the draft Bill is based very largely on the Indian Forest Act: it retains the perhaps old fashioned arrangement of division into chapters because the Forest Officers who are members of the Committee say that this is found in practice to be most convenient. The following paragraphs will be found to be very largely a commentary on this draft Bill.

It must be understood that although such members of the Committee as are also members of the Legislature have accepted the principles embodied in the draft Bill they reserve the right to state their own views on matters of detail at a later stage if necessary.

CONTROLLED FORESTS: WORKING PLANS.

58. It has already been indicated that the Committee are convinced of the necessity for the conservation of the forests in Western Bengal. They consider that powers must be taken by legislation to compel every owner of a forest there to manage it in such a way as to prevent serious deterioration and consequent erosion; and that, if an owner will not or cannot do this, Government should step in. They do not however think it either necessary or desirable that Government should actually take over the management of all forests. Earlier paragraphs

have shown that a fair proportion of the larger forests are b
managed well enough as it is to avert deforestation and ero
though not as a rule well enough to secure for the owners the
possible yield: and others might possibly be so managed if their ow
were (to adapt the opinion expressed in 1928 by Mr. Cook who
then Commissioner of the Burdwan Division) forced to take
intelligent interest in the problem by getting a shock in the
of legislation. Those owners who are in a position to manage
forests properly but have so far failed to do so through apath
ignorance should, in the opinion of the Committee, be given
chance to show what they can do: and those who are managing
forests well already should be left to manage them still. All
should be assisted by being given expert advice and should to
extent be controlled. It seems to the Committee that the co
could most conveniently be exercised [*clause 3*] by imposing on e
owner an obligation to prepare, and to follow, for each of his fo
a working plan such as has been found to be essential for the scien
management of forests in all parts of the world. A working pla
not a map but a programme. It can be simple or elaborate, as
be seen from Mr. Simmons' note which forms Appendix VI to
report; and it will usually provide for equal returns each year (o
suitable intervals) and for an equal amount of work to be don
each, so as to meet the convenience of the owner and to give
forest-staff enough, and no more, work each year. But the esse
thing in the working plans to be prepared by the forest owners u
these proposals is that they should show precisely on what areas
trees are to be cut in any given year. The areas would have to b
chosen that the trees were not cut too often: and it is there
necessary that the plans prepared by the owners should be subje
modification by experts [*clause 3(3)*]. Experts however are p
to demand the ideal, and the Committee therefore propose [*clauses
and 1(5)*] that where owner and expert disagree the decision w
rest with a standing Appellate Committee composed of the Colle
of the District, a Forest Officer and an owner of a private f
to be selected by Government from a panel appointed for the Reg
The details of the plan would be such that no unduly sudden cha
would be made in the manner of working a forest, unless condit
were such as to make it quite unavoidable; and it would naturall
drawn up so as to meet the wishes of the owner as far as possible.
would have to be elastic in some degree: and therefore it would
necessary at times to allow departures from it to a reasonable ex
[*clauses 3(7) and 3(8)*]. Many of the witnesses objected that it w
be unfair to prevent their taking advantage of any sudden,
perhaps shortlived, favourable change in the market prices, me
because a plan had shown so much and no more to be cut that ye
this is reasonable enough, and the usual method of using a work
plan provides for it. It is usual to allow "deviations" under pr
authority (which would be in practice the Conservator of Forest
an officer authorised by him), or, in other words, to allow in
year felling in excess of the figure shown in the working plan, prov
that there are correspondingly smaller fellings during the remai
of the rotation: and this is what would be done under the Committ
proposal. The ruling principle would be that during the pe
covered by the working plan no area would be cut more often t
allowed by the plan, though the year of cutting might to some ex
be altered. To enable check to be exercised, [*clause 51(c)*] ow

would have to inform the Forest Officer in charge, called the Regional Forest Officer in the draft Bill, of the dates when particular areas were to be felled over, and to submit "control forms" which show the fellings actually made. An owner who wanted to deviate from the working plan would give intimation beforehand to this officer who would obtain the approval of the proper authority. Needless to say, the standard by which a working plan would be judged would be the likelihood of its restoring forests to, or keeping them in, a condition where soil erosion would be improbable: and there would be no question of forcing owners to accept working plans, however admirable in themselves, which aimed at more. The whole object of a working plan would be baffled if owners felt free to depart from it at their pleasure: and it is therefore proposed [*clause 4(1)*] that they would be liable to prosecution if they did so and that if they repeated the offence Government would be able to step in and assume management. But here too there would be a safeguard [*clause 4(2)*]: management could not thus be assumed unless the owner concerned had been given the opportunity of showing cause before the Appellate Committe and unless the Committee recommended such a step. The period over which the management would rest with Government would be determined by the Committee.

VESTED FORESTS.

59. For convenience the Committee have used the term "vested forests" to describe forests of which the management has been assumed by Government, for the reason that their control would be vested in a Regional Forest-officer. It is an important feature of the Committee's proposals that it should not be necessary in every case to wait till owners had failed to adhere to a working plan and had been prosecuted, before control was thus taken over. All this would be obviously a waste of time and an unnecessary cause of annoyance to an owner who preferred to leave the management of his forest to Government: there might be some who would prefer to apply for such management under agreement. But, apart from this and more important, there is the case of forests which could not possibly be managed by their owners properly and for which the preparation of working plans would be merely a farce as things stand. In particular there are the small forests belonging to shareholders among whom it is useless to expect agreement and there are the forests too small to justify the employment of proper staff to look after them. Unless there is a system of proper guards forest protection is impossible: but a forest of a couple of hundred acres cannot bear the cost of such guards if treated as a unit. It is proposed therefore [*clause 5*] that, if the Appellate Committee so recommend, Government may by notification assume control of any forests of which they are satisfied that the conservation cannot safely be left to the owner, without first giving the owner the option of managing it under a working plan. This is a drastic provision and is comparable to that proposed by the Stephenson Committee: but its justification is the fact that the only alternative is to leave considerable areas to degenerate into barren waste. As the reason for the assumption of control in such cases would not merely be the condition of the forests, it is not proposed that the Appellate Committee should recommend a period for which the control should last. The terms on which Government would work the

forests would be less favourable than those fixed in the Bihar agre ments previously discussed: the whole cost of management and improv ment would be borne by the vested forest and there would be no questi of writing off any adverse balance at the end of every year to begin wi or of every triennium later [*clause 10*]. To write off losses means pay them from the Government revenue. There is no reason why forest owner should be rewarded for having allowed his forest to get in a bad state, by its being restored to a proper condition at the cost of t provincial revenues. The owners would be safeguarded by the provisi proposed in clause 12 for the release of vested forests after certa periods if, subject to conditions, the Appellate Committee consider it be safe to order it. There would of course be working plans drawn by the Forest Department in respect of all vested forests, and, as matter of executive working, these would be discussed with the owne Details of the methods of management of vested forests and proposa for tiding the owners over any initial period in which the returns fr the forests were lower than at present are discussed later. It may said that a majority of the witnesses who were examined by t Committee admitted the necessity for action on these lines, thou most of them were strongly of opinion that owners who could point a reasonable prospect of managing their forests adequately themselv should be left to do so until they proved that they are incompetent lack any real desire to do so.

AMALGAMATION OF VESTED FORESTS.

60. A very difficult problem is presented by the many small fores some of which are only a few bighas in extent. It must be recognis as a fact that the Forest Department cannot manage small forests independent units except at an altogether prohibitive cost. If the fore the small forests are to be saved from destruction, there mu be provision for their being amalgamated for purposes of manag ment. It would cost too much to provide staff for the protection a management of units of less than about 1,000 acres composed of fores either contiguous or not far apart. Amalgamation would facilita the preparation of satisfactory working plans, would enable arrang ments to be made for modifications in rights of grazing and the lik would make protection against damage (especially by grazing) much more simple affair than it would otherwise be, and would increa the price obtainable for the forest produce. There is not the lea doubt that the small man gets worse prices for his forest than t owner of large forests: contractors do not find it worth while to b for the small coupes and the price is fixed merely by the local deman Naturally this is not very great and it seems clear that some of t small owners have fallen into the clutches of groups of small dealer The same forests, if worked as large units by Forest Departme Officers who are in touch with big contractors, would fetch muc better prices. Apart from this it would seem that there are comp ratively more co-sharers in the smaller forests (which have becon small precisely because there are many co-sharers) and joint manag ment by the Forest Department would lead to a very great improv ment in the yield from these: the prospect of such management bei possible is conditional upon amalgamation. It is proposed [*clause* that the Regional Forest-officer should be given power to order that

group of separate forests should be managed as if they belonged to one owner, subject always to an appeal to the Appellate Committee [*Clause 7 (2)*]. It is hardly necessary to say that isolated groups of much less than 1,000 acres in all would have to be left to the management of their owners unless there were prospects of increasing the area by reafforestation. If several small forests, less than 1,000 acres in the aggregate were situated in the neighbourhood of a somewhat larger forest managed sufficiently well not to necessitate its being taken under Government management for its own sake, it might be advisable in the public interest for its control to be vested in the Regional Forest Officers so that its management might be amalgamated with that of the smaller forests. This would enable forests to be saved which otherwise would be lost. But it may be stated that the Committee did not come across any such small but well managed forest in the course of their tour: and the possibility is mentioned only as an extreme illustration of the manner in which the suggested procedure would work. There would be no difficulty about allotment of costs when several forests were managed jointly in this way: if any special expenditure was incurred for the benefit of a particular forest, (as for example for plantation or for protection against diluvion by a river) it would be charged against that forest only, and otherwise the total cost of managing them all would be divided among them on an acreage basis [*clause 10 (1)*]. As the stocking of each forest would vary very greatly, it would be impossible to divide profits among them on this simple acreage-basis: and it would be necessary to calculate the yield from each forest separately and to credit or debit it each year with the difference between the value of its yield and its share of the working costs. There would be no particular difficulty about this: it is the system which has been followed and which is working smoothly in the private forests under Government management in Dacca and Mymensingh districts. It would probably be possible to arrange by special agreement that rights of grazing and wood cutting in individual forests should be commuted for rights in a particular area in one or two of them: in such a case the owners of that area would have to be compensated by the owners of the other forests which profited by the arrangement.

RELEASE OF VESTED FORESTS TO THEIR OWNERS.

61. The Committee consider that the time will never come when it will be safe to leave forests in Western Bengal to be managed without insistence upon working plans: but it does not seem necessary to allow Government the power to retain indefinitely the control of private forests, and provision is therefore made in the draft Bill for returning to the owners the forests of which the control has been vested in the Regional Forest-officer when it becomes safe to do so. At the outset, when a forest is taken under Government management, no one however expert could say with confidence how long precisely it will be before the trees have recovered and the surface soil has been built up again sufficiently: and the obvious course is to have the condition of the forests reviewed periodically. This must not be too frequently, because if there is too great an element of uncertainty the officers in charge of a forest will hesitate to take a long view when making plans for its maintenance. The provision which the Committee favour [*clause 12*] is that an owner should be allowed to have

the situation reviewed after 15 years and that it should always reviewed after 30 years, a period which normally should prove enough for the forest to be restored to a reasonably good state. conditions would have to be satisfied before a forest was handed to its owner: first, Government must have been reimbursed all that been advanced for the restoration and upkeep of the forest, secondly, there must be a reasonable prospect that the forest can maintained in a satisfactory state. In most cases the existence working plan and the knowledge that neglect could lead to prosecu and perhaps a further period of management by Government shoul sufficient inducements to an owner to manage properly the forest v it was restored to him: and in most cases therefore forests would handed back to their owners as a matter of course after the 30 ye But it might not be prudent thus to hand back a fo if this threatened to make the management of other for which had been amalgamated with it prohibitively expensive, or were inextricably mixed up with other forests (so that its release w mean an undue risk of illicit felling) or if it were so small as to m it unlikely that it would escape deterioration. The forces which brought about the complete or partial destruction of forests will cease to operate because 30 years have elapsed: and it would be a waste of energy and enthusiasm to allow an owner to squand forest which had been restored by Government management. The of course the precedent of Court of Wards Estates which not in quently become encumbered again soon after their release to owners: but it is not a precedent which should be followed, an seems wise to make provision for the prevention of any such misus forests. The proposal [*clause 12 (1), second proviso*] is to allow Appellate Committee power in exceptional circumstances to direct even after thirty years forests which have been amalgamated for poses of management by Government should remain under management.

AFFORESTATION IN WESTERN BENGAL.

62. It has already been shown that it will be disastrous to as they are the areas from which forest has disappeared; but it question whether it will be possible to get *sal* trees to grow again those areas or whether it can be done at less than a prohibitive The difficulties are obviously enormous. It is necessary at the ou to remember that *sal* seedlings will not grow into trees if they do have sufficient surface soil in which to make root-growth: if the sur soil is too thin, it will not hold enough moisture, and it will al certainly be lacking in essential food elements when it has become thin owing to erosion. It is impossible to say what is the minim depth of soil in which *sal* seedlings can develop into trees; and Committee have very little information as to the actual d of soil on the denuded lands. It does not follow that because *sal* died out on the edges of forests the soil was not sufficient for seedli and the evidence pointed the other way. In many places visited by Committee the *sal* seedlings on the edges of forests had beyond sort of doubt been grazed upon by cattle. But the point is of l importance, for once the forest disappears the surface soil also quick to disappear and regeneration is then no easy thing. Certa there are spots where the soil is sufficient for reafforestation.

Committee saw one and heard of one at Jhargram in Midnapore. The latter was mentioned by the Manager of the Jhargram Estate: it is an area of about 80 acres where forest had disappeared owing to heavy grazing: the soil which was still a foot or so in depth was ploughed and *sal* seeds were sown broadcast: there was no dying back and at the end of three years the trees were eight feet high. This result was obtained without fencing: but forest guards were posted to keep off the cattle. The other instance of afforestation was seen by the Committee in the interior of a forest belonging to the same estate. It was a plot of some 8 or 9 acres covered with flourishing *sal* saplings which were said to have been grown from seed similarly broadcast: this area looked as if erosion had not been serious. On the other hand an experiment made in 1920-21 by the Burdwan Raj estate near Sonamukhi in Bankura was a failure: in this experiment three bighas of *danga* land were ploughed in June and *sal* seeds were sown broadcast, after being collected from the ground under the mother trees: about 40 per cent. germinated but the seedlings began to die in the following November and practically all were dead by the next April. The Forest guard of the Burdwan Raj estate, Mahabir Singh, who gave this information at Patharmara, says that the area was not fenced and that there was grazing by cattle when the watchmen went away: it is possible that the experiment might have succeeded if cattle had been kept off and it is possible that the dying of the seedlings in November was merely the dying back to which reference has already been made as normal on poor soil: but it is quite likely that there was altogether too little surface soil with insufficient moisture. It seems probable that the places most likely to respond to reafforestation are the plots of land, cultivated perhaps one year in three, that are to be seen on the outskirts of many forests. As cultivated land they give a miserably small return: the rent paid for them is only a few annas an acre. They would be better under forest, for they would probably give a bigger return and they would certainly be less exposed to erosion: at present they are exposed to it in two years out of three and even when there is a crop it is not such as to protect the soil. These plots could be afforested if they were treated as part of an adjoining forest. It would be useless normally for Government to undertake their afforestation except as part of a scheme for afforesting wide stretches of *danga* land, if such a scheme is proved by experiment to be feasible: but the object could be attained if arrangements were made for such plots of land to be handed over to the owner of a neighbouring forest who would not have to supply a separate staff to guard them. It is only through decentralisation that they could be brought back under forest. This agrees with the view expressed by Mr. J. C. French, Collector of Bankura, in 1926: "in my opinion" he said "it would be utterly impossible for Government to do the work" of reafforestation "directly, as the area covered is so large and the places to be afforested are so small, scattered and enormously numerous." Mr. French, it will be observed, did not even conceive the possibility of an attempt to afforest the eroded lands: yet if these are not taken in hand the results of reafforestation will be comparatively small. Where the erosion has removed all the subsoil and exposed the laterite rock, nothing can be done: but over most of the areas under consideration this has not happened. As has been mentioned earlier, sheet erosion of the subsoil often proceeds until a thin impervious stratum is reached and then practically ceases. It has

been found that, if this thin impervious stratum is broken and the subsoil below it ploughed, vegetation can grow on it: Bankura, Rai Bahadur Satya Kinkar Sahana has shown that sufficient care such subsoil can be made to grow even paddy two seasons' ploughings. In theory therefore it should be possib get forest to grow again on these lands. The process would not be *Sal* seeds have to be sown at the beginning of the rain: cannot be kept long for they lose their fertility very quickly: an is therefore a great handicap that the impervious stratum and the su are so hard as to defy the plough until the rains have set in. By the time the soil can be broken the seeds will have lost fertility; and the odds are that before the rains of the subsequent the ploughed land will have been badly eroded. In Western Bengal districts, as Mr. C. K. Homfray pointed out in 1 the rains often break in the form of storms at intervals of six seven days: if seed is sown on a hastily ploughed soil after on these storms it may easily be dried up before the next unless eva tion is checked by some method of shading the soil: and would mean the planting of some shade crop at considerable expe It would be pessimistic to conclude that shade is always essential, the successes on the Jhargram estate disprove this: but reaffor tion is bound to be very slow if it has to wait till a soil is built up before it can even be started. It is impossible to es from the conclusion that experiments ought to be made with a to working out a fairly cheap method of reafforestation. These been recommended consistently by the Forest Department. In Mr. Shebbeare suggested the trying of experiments. In 1927 Mr. C Homfray said "All these problems can only be solved by ex ments and they should be started at once." In 1928 Mr. said "To explore all the possibilities of reafforestation it is esse that a systematic survey of the available areas should be comme at once and this should be combined with a series of experim on various classes of waste lands with a view to determine best methods of dealing with different soils." Mr. Benskin, suppo this recommendation, commented "I feel that a great deal of rese work will be necessary before it is known whether these areas can afforested or not," and added that the only concrete proposal w he could make was to maintain and extend afforestation experim Finally in May 1937 Mr. Meiklejohn suggested that no reafforesta work should be undertaken until the possibility of carrying out f work of this nature had been examined in relation to famine re The suggestion has been made that the success of operations in United Provinces and in Chota Nagpur has proved the possibility successful reafforestation in Western Bengal without preliminary ex ment. This the Committee cannot support. Conditions in United Provinces are certainly quite different from those in Wes Bengal, for there the areas to be reafforested are sandy and pre tion of grazing by itself leads to the growth of new vegetation: conditions in Chota Nagpur may or may not be comparable. It w be extremely rash to embark upon reafforestation on a large s on the basis of the information already possessed by the Forest De ment. Even as a measure of famine relief the indiscriminate brea up of the soil, in the hope that this may facilitate the re-establish of tree growth, is not advisable. The idea of using fa labour for this purpose in Bengal originated with Mr. Benskin had seen it utilised in the United Provinces to better

economic condition of the people by improved grazing and fodder supplies: he claimed for it the advantage that "it affords tasks for almost every conceivable class of labour and the work can be closed down at any time without leaving it incomplete." The truth of this however depends on the existence of an organisation to make use of the work which is done. Upkeep has to be considered: young trees need attention and protection: and for this a permanent staff and a permanent labour force would be needed. The cost of this would be considerable. It is futile to expect that this expense could be avoided by getting the local people to guard young plantations; they have allowed forests to disappear for lack of a little forethought and the same cause would prevent them from nursing plantations. A Government staff would be essential and until there is such a staff in the districts it is useless to start work with famine labour. When the time comes for such work to start, the famine labour could probably be used best in the following manner. Mr. Benskin had, earlier in the same letter, drawn attention to the possibility that certain operations for the reclaiming of soil deficient in plant food, such as is mentioned above, might have the same success in Western Bengal as they have had in Italy. They consist in the digging of drains along contour lines so as to catch the surface water and to cause the silt carried by it to be deposited; the silt is cleared out of the drains each year and thrown on the down-hill side of the drains; and eventually the terraces thus formed can be planted. This can be combined with the system of making small embankments across depressions with a view to holding up water and catching silt. Work on the former system has had encouraging results in some of the Chota Nagpur forests, and the latter under quite different conditions has been successful in the United Provinces. It must be recognised that a certain amount of upkeep would be necessary even before the plantation stage was reached, because if the drains or the embankments are overtopped by accumulated rain water there is a danger that heavy cutting may set in. This has been experienced in the United States of America. It seems to be probable, however, that when Regional Forest-officers with suitable staffs have been appointed such upkeep could be arranged for: and, if this were done, famine labour could be used to advantage to make contour drains and embankments, to break the impermeable crust on *danga* land and hoe up the soil, and even to dig contour tanks along the lower boundaries of forests or of possible-forest areas, as advocated in 1925 by Mr. Shebbeare as a means of "slowing the run off, retaining water and causing the surface-water to percolate." When the land had thus been prepared it would probably have to remain for a few years under some variety of grass until a soil had been formed rich enough to give the seedling roots a start; for a grass can find nutriment in soil far too shallow for a tree. But, however probable success may be, there should be experiments made before such measures are adopted even if a maintenance staff is available. The Committee's proposals embodied in clauses 8 and 9 of the draft Bill are that there should be provision for handing over the inferior cultivated lands on the edges of forests to the owners of those forests for afforestation, in return for suitable compensation and subject to payment of rent to the landlords of the lands if these are not the owners of the forests, as they very often will be; and that where it seemed possible to afforest waste land Government should be able to declare its control to be vested in a forest officer for a specified period. There would be a reference to the Appellate Committee if

any owner of waste land objected, and the release of the land to the owner would be considered after 15 years and 30 years as provided regarding vested forest. It might take more than 30 years before the profits from reafforested lands were sufficient to pay off the capital which would have to be invested in them: but the lands at present are of no practical use to the owners and any profit which did come to them would be pure gain.

CONSERVATION AND AFFORESTATION IN OTHER PARTS OF BENGAL.

63. There has been a suggestion that the Committee's proposals regarding afforestation in Western Bengal should be applicable to other districts. There are, it is believed, some areas in Dinajpur where conditions are similar to those in Western Bengal, in that destruction of forests in them means serious erosion; and there may be others in other districts; to such areas all the considerations justifying the Committee's proposals would apply, both as to conservation of forests and to afforestation. But the suggestion relates to other districts as well, where the need for afforestation must be justified by different considerations. There are for example parts of Nadia district where villages and cultivated land have relapsed into jungle owing to the growing infertility of the soil caused by the decay of the rivers which used to spread fertilising silt. A report by Mr. S. K. Basu, Extra Assistant Conservator of Forests, published in 1938, describes the present state of Srinagar mauza in Chakdaha thana, once a flourishing village and a country residence of the Nadia Raj, as follows: "the whole area of more than 2,500 acres is at present nothing but jungle land—an entangled mass of bushy scrub jungle interspersed with trees, where jackals and leopards roam about, while through the thickets can be made out ruins of old temples, brick built houses, paved streets and ghats, large tanks and moats": and it goes on to say that "there are such areas of large or small extent scattered throughout the district." Obviously the reason why afforestation is proposed for such areas is not a risk of deforestation and erosion but the desire to replace useless jungle by useful timber trees: and it may be held therefore that there is no real occasion to give Government powers to declare such areas vested in a Forest Officer for purposes of afforestation. There is however force in the argument that both cases present the same fact that land is lying useless which might under Government management become valuable to the owners and to the province: and there seems to be no reason why the remedy suggested for the denuded areas of Western Bengal should not be made applicable to the decadent areas elsewhere. There is of course the possibility that in the decadent areas big irrigation schemes would have the effect of restoring to a cultivable state tracts which have relapsed into jungle: but there is no likelihood that any Government would attempt to put under forest land which could more profitably be used for crops, and there now appears to be no prospect that such irrigation schemes will be taken up in the near future. The Appellate Committee should be an adequate safeguard. It would therefore seem unobjectionable to provide that the clause in the Bill regarding afforestation of waste land should be made applicable to waste land anywhere in Bengal. For this reason the extent of the Bill has been shown in clause 1(*2*) as not only the four

districts covered by the terms of reference but also areas in any other districts to which it may be extended by notification after objections have been considered. The Indian Forest Act contains a provision in section 38 that a forest may by agreement be brought under Government management as a reserved or protected forest if an application is made by the owner or by owners of at least a two-thirds share of the forest: it has been found in practice that it is very difficult to get co-owners of so large a proportion of the total to agree to make an application and it seems advisable to alter the provision in such a way as to make action possible if owners of an aggregate of more than half the shares apply. This has been incorporated in the clause which has been inserted in the Bill with the object of allowing all mention of private forests to be omitted from the Bengal Forests Bill when this is drafted to replace the Indian Forest Act.

SABAI GRASS.

64. The possibilities of *sabai* grass as an agency for forming new surface soil on eroded land and thus facilitating afforestation in Western Bengal are important enough to justify its further discussion. A note prepared by the United Provinces Forest Department in which its cultivation is described is printed as Appendix VIII. This note describes its yield when it is grown on fairly good land, a well drained sandy loam about a foot deep if possible: it is natural to ask how the grass would grow on the sterile-looking *danga* lands on which it would be necessary to grow it in Western Bengal. Actually there are places where it is being grown already in those regions. Mr. Benskin, Conservator of Forests, wrote in 1928, regarding 300 acres given up to it, near Kharagpur, that what struck one on seeing the farm was "the complete cultural success of the venture", the whole being completely stocked with lines of *sabai* at intervals of one by two feet. He described the soil as typical of much of the denuded land and said that the method of raising the grass was simply to plough the land and dibble in bunches of roots during June and July: "they quickly take root and yield quite a substantial crop in the following November." The Midnapore Zamindari Company have leased out for planting with *sabai* grass 240 acres of "Waste land" near Chandrakona Road, 2,400 acres of "*danga* land" between Amlagora and Goaltor, and 1,120 acres of "*danga* land" in other parts of Midnapore district: Major Scott, the General Manager of this Company, described the land which was being put under *sabai* grass as high level *danga* land. In Bankura Babu Ramkinkar Mandal, a tenure-holder, told the Committee at Basudebpur that he had settled a big area of *danga* land at a rent of 3 annas per acre for *sabai* grass plantation, but did not say how it was progressing. In Burdwan the Raniganj Paper Mills are experimenting with bamboos and *sabai* grass on some *danga* land of the Bengal Coal Company; and Mr. F. G. Williams of the Ushagram Educational Colony near Asansol has experimented with it on a small scale since September 1936. The method used by Mr. Williams was as follows. About 1,000 roots were set out in September 1936, in rows about 3 feet by 3 feet apart: there were 4 cuttings in 1938 but none in the first two years: the roots are spreading and this year ought to give a 50 per cent. larger yield: in 1938 2,000 more roots were set out on an adjoining plot, and, Mr. Williams adds "now that we see how well it grows

on "*danga*" "morom" soil, we hope to extend the plots each year till we have covered our waste land. As to cultivation we clean the plots of weed once a year. The *sabai* grass is not irrigated. Goats and cows will not eat it, therefore we need no fencing. The plots are high *danga* land fit for nothing else....."It grows slowly after the rains and very fast during the rains." The cost of cultivation at Kharagpur was said by Mr. Benskin to be Rs. 5 per acre each year for ploughing between the rows and thinning out congested grass plots: the cost of the roots at Rs. 40 per maund was the chief item when the plantation was laid out and it pays to grow grass for planting other areas. The Midnapore Zamindari Company say that the initial outlay is Rs. 20 per acre (without fencing) and that after three years the revenue is about Rs. 42 per acre. The Agricultural Officer of Midnapore gave the following figures per acre:—

Year.	Cost.	Receipts.	Net expenditure.	Net profit.
	Rs. a.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1st ..	18 2	6 1 6	12 0 6	..
2nd ..	6 4	18 4 0	..	12 0 0
3rd ..	8 2	27 6 0	..	19 4 0
4th ..	11 14	45 11 3	..	33 13 3

These figures include rent and salami (spread over 10 years) at 10 annas per acre, and fencing (spread over 10 years) at Re. 1-4 per acre: they provide not for ploughing the whole area but for hoeing patches 2 feet square in which the root tufts are planted: the increase in cost after the second year represents wages for cutting a heavier crop. Outturn from *danga* land is reported by the same officer as being roughly as follows (in maunds):—

Year.	First cutting (August).	Second cutting (January).	Total.
1st	..	5	5
2nd	10	5	15
3rd	15	7½	22½
4th	25	12½	37½
5th	25	12½	37½
6th	25	12½	37½
7th	20	10	30
8th	15	7½	22½
9th	10	5	15
10th	5	2½	7½

When the outturn falls below the economic limit, the plantation is abandoned and a new one is started with the rootstocks of the old.

Naturally the cost and the yield vary according to the nature of the soil and the amount of work put in: but generally speaking the figures given are encouraging. There should be a ready market for large quantities of *sabai* grass: it is excellent material for paper making and is also used for making ropes. Mr. Nath in 1928 found *sabai* grass being grown by villagers in Bankura district to supply what they needed in the way of ropes and mentioned a large local demand that was met by import from Bihar. The Ushagram Educational Colony uses all that it produces for making rope for stringing beds and the like.

FOREST SETTLEMENTS.

65. It is no mere coincidence that the forests where there is least deterioration are those over which neighbouring villagers have no rights. As far back as 1910 Mr. Pigott, Manager of the Dhalbhum concern of the Midnapore Zamindari Company mentioned as the chief cause of forest destruction the fact that the Settlement Officer in certain districts had "created wholesale rights on behalf of the raiyats" over forests and so had deprived the owners of the power of control necessary for their preservation: he mentioned particularly that this had not been done in the Company's Midnapore forests and it is a confirmation of his view that the Dhalbhum forests were so badly damaged while those of Midnapore have comparatively speaking escaped. The difficulty is that the people are not prepared to show moderation in the exercise of their rights: their general attitude is like that of the co-sharers already mentioned who imagine that to refrain from the full exercise of a right is to give something away to other people. Mr. Robertson in his Bankura Settlement Report commented upon the "total absence of even the most restricted and local form of public spirit," and, although the people have to some extent been educated by the rural development movement, the remark is still true of their attitude towards the exercise of their rights over forests. It cannot be said too often or with too much emphasis that the unrestricted exercise of rights of grazing and cutting will destroy any forest. The recorded rights of the people are in many areas utterly incompatible with forest conservation. It is impossible for forest to regenerate if grazing is allowed immediately after clear felling as in the Hetempur estate forests in Birbhum, three or four months after it as claimed in the Nayabasan forests in Midnapore, or six months after it as near Medinipur, Chingani and Beliator in Bankura: and the provision that one year should elapse as at Gangajalghati, Patharmara and Basudebpur (where it was specially mentioned that damage resulted) is not very much better because by that time the saplings will have had only one growing season ("one rains") and will still be young and tender. To allow grazing after two years would probably be safe. Some Forest Officers advocate the complete prohibition of grazing in forests but as Mr. Benskin remarked "in any forest project, however distasteful it may be to the instincts of a Forest Officer, provision must be made for the grazing and browsing of cattle in the forests, although certain restrictions must be enforced to effect even the slightest improvement." Apart from rights of grazing there are rights of cutting which have already been mentioned as causing harm. The most extreme form in which this right was claimed was found in the contention of tenants at

Nayabasan that the zamindar ought not to sell any timber to contractors because the only business which the tenants could practise in so backward a place was the sale of timber which they are allowed to extract at preferential rates: this amounted to a claim that the forests should practically be treated as belonging to the people who lived near them and whose fields had originally been carved out of them: and it is not surprising that people who have such ideas of their rights should be said to be injuring the forests. The right to remove leaves is another right which for reasons already given has to be controlled if forests are to survive. Apart moreover from the necessity for regulating the times and the places at which rights should be exercised there is the necessity for regulating the extent to which such rights should be exercised by each individual. When a man has a right to take a headload of wood for his own use from the forest, it is absurd to argue that on his death his five sons should each be allowed to take a similar amount because each gets a share in his land: and because a man with a few bighas of land, who might normally be expected to have at most a couple of animals, has a right to graze cattle in a forest it should not follow that he must be allowed to turn professional grazier and send in twenty. Two things are clearly required: first that the existing rights should be defined and secondly that where existing rights are likely to damage the forests there should be power to modify them. The existing rights have been recorded in the Settlements, but there is still some doubt precisely what was meant by the record and the people claim that they have in addition customary rights not mentioned in Settlement records. Where a serious attempt is being made to conserve forest, there should be a forest settlement during which existing rights over the forest are recorded and steps are taken to modify those which are unreasonable, after payment of compensation or after commutation for other rights. As the cost of this must be met from the profits of the forest concerned, and as owners who manage their own forests may not think it worth while to pay them, it has not been suggested in the draft Bill that there must be forest settlements in all forests: it is considered sufficient to provide that there may be a forest settlement of any controlled forest if the owner applies for it [*Clause 14(1)*]. When however a forest is vested in a Regional Forest-officer, it seems highly necessary that all rights should be defined as early as possible: and there is therefore provision in the draft Bill that when a private forest is taken under Government management there must be a forest settlement. The detailed provisions for this are the same in a simplified form as those in the Indian Forest Act. The Committee found one example of commutation of rights in a forest, by compromise in a civil suit, which deserves particular notice on account of its simplicity and of its success in practice. This was in the Ramgarh Estate in Midnapore where the tenants had exchanged ill-defined rights over the whole 6,558 acres of forest for defined rights over 400: these 400 acres are worked in 5 blocks, on a rotation of 5 years, on behalf of the tenants: each year all the trees on one block are felled (except species like *peasal* which are reserved for the landlord) under the supervision of the zemindar's men, and the wood from them is distributed among the tenants, at nominal rates calculated to meet the cost of cutting, according to the size of their holdings. This prevents the indiscriminate cutting of firewood which usually brings shareholding systems to disaster; has the great merit of preventing the dishonest extension of rights fixed under other circumstances, such as selling in bazars wood taken ostensibly for the

man's own private use; and appears to be worthy of imitation on a wide scale. The draft Bill provides that no right of ownership should be abolished or modified at a forest settlement [*Clause 19* (*1*) (*b*)]: no matter how dangerous to forests the co-sharer system is, it would be highly undesirable to leave it open to officials to eliminate a number of co-sharers under these clauses. But for convenience of administration a clause has been inserted authorising a Forest Settlement-officer to determine who are to be recognised as co-owners of forests taken under Government management and what their shares are [*Clause 10* (*4*)]: any one who felt aggrieved would have to go to a Civil Court.

GRAZING OR FODDER CROPS?

66. There is so exaggerated a belief in the value of the *sal* forests as grazing grounds for cattle that it is advisable to discuss the point in greater detail. The remark that the only grazing grounds are the forests has already been quoted: but it is not generally realised that there is very little grass in these *sal* forests and that the cattle which feed in them are mainly leaf-eaters and, what is worse, by preference eaters of young and succulent leaves. It is frequently said that the grazing grounds are useless for the purpose because they are practically bare of vegetation at the time when it is most needed: but the reason why the grazing grounds are bare is that they have lost their soil owing to the erosion which followed the destruction of the forests and beyond any doubt that destruction was due to grazing very largely. The value of the forests for grazing purposes is obviously small: the cattle in the villages near them and the cattle actually seen feeding in the forests were miserable specimens. They appeared to be no less miserable than the cattle in villages at a distance from any forest, and it is a question whether they would be much worse off if kept out of the forests altogether. Near Susunia in Bankura district where cattle used to graze in the forests they are no longer allowed to do so because the forests are now cut every year: the interesting thing about this is that no one seemed to think that this deprivation was very important and indeed a glance at the forests in question showed that it was not. The same may be said of the areas where the forests have entirely disappeared. The position may in fact be summed up thus: the grazing of cattle in forests does unmeasured harm to the forests and very little good to the cattle. How that harm is done has already been described: regeneration is prevented by the destruction of young shoots and of leaf, and erosion is facilitated by the trampling down and hardening of the surface soil so that absorption is reduced. The solution is obvious: a fodder crop ought to be grown for the cattle in these barren districts, not only near the forests, as a substitute for leaf grazing, but everywhere: and the obvious fodder crop is Napier grass. A description of the manner in which this can be grown has been attached to this report as Appendix IX. For this crop to give its best, it should be grown on good soil with heavy manuring: but the question here is not how it can give its best but whether on the poorer soils in these Western Bengal districts, soils which cannot grow paddy to advantage, Napier grass will give a sufficient yield. That it will grow on certain types of *danga* land (not the most barren, as need hardly be said) has been established: it has been grown successfully on such lands both at

Suri and at Bankura Agricultural Farms: and Rai Bahadur Satya Kinkar Sahana has grown admirable crops of it near Bankura town on land that used to serve as a source of gravel for roads. This was with irrigation and the greater part of the Napier grass at the Agricultural Farms also was irrigated: but the Committee saw at the Suri farm Napier grass grown without irrigation and apparently doing well. Only one of the witnesses examined (Babu Satish Chandra Ray, at Medinipur in Bankura) had personally tried growing this grass: he had been successful with one bigha only, at an initial cost of Rs. 3-12 per acre, without any fencing: but the Committee were told by the Collector of Bankura that a good deal of Napier grass is now being grown in the district. It is no objection that without irrigation crops of Napier grass cannot be expected at the season when the cattle most need fodder: for Napier grass is very well suited for the making of silage, and it should not be difficult, if the people were willing to try, to store it in pit silos during the rains and use it months later when the need for fodder was greatest. This is in accordance with the recommendations of the Royal Commission on Agriculture in India, who recommended the earthen pit silo as not only the cheapest form of silo but also the type best suited for cultivators. The use of such pit silos has been taken up by some few of the cultivators in Birbhum where a better-cattle movement is making progress: and it is established beyond any doubt that they are quite suitable for local conditions. It goes without saying that it will not be easy to bring about a change in the habits of the cultivators, especially when so many of them are Santals: but the fact that fodder can without difficulty be grown in the rains and stored for use at any time of the year, and that this would provide far more nutriment for cattle than the leaves and inferior grass of the *sal* forests demolishes completely the argument that even if uncontrolled grazing is fatal to the forests consideration for the poor cultivators demands its continuance. The view that whatever happens there must be no interference with grazing rights is illogical, and there is every justification for the practice, already established, that where forests have to be encouraged grazing rights must be modified and controlled.

PREVENTION AND PUNISHMENT OF FOREST OFFENCES.

67. The preservation of forests is always difficult because their very size makes it easy for offenders to escape detection, because identification of forest produce as coming from any individual forest is very difficult, and because courts tend to impose inadequate penalties for offences each comparatively trivial although their cumulative effects are disastrous. In every country therefore where there are Government forests there are special laws to facilitate action against forest offenders. India is no exception and the Indian Forest Act gives the necessary powers to Forest Department Officers in respect of Government Forests: these powers can under that Act be exercised in respect of private forests also of which the management has been taken over by Government: and it has been assumed that they will be given to the Forest Officers who are entrusted with the management of vested forests if the draft Bill becomes Law. The relevant clauses in the Bill are based upon those in the Indian Forest Act. The only matter which calls for comment in this connection is that the draft

Bill contains nothing corresponding with sections 41-44 of the Indian Forest Act which govern the control of timber and other forest produce in transit: the reason is that those sections apply to all parts of Bengal and there would be no object in giving the same powers a second time in respect of specified districts. Rules under sections 41 and 42 would be absolutely necessary in respect of the transit of timber near vested forests and they would be of the greatest assistance for the conservation of controlled forests also. The Stephenson Committee drew attention to the fact "that private owners are not in a position to preserve their own forests without help"; preservation could be effected only by the maintenance of a staff beyond the means of the owners or "by the personal influence of the proprietor"; but "the authority of the zamindar in forest matters is only proportionate to his influence and power over his raiyats in other directions, and this must in the nature of things gradually weaken." It has certainly weakened greatly since 1909 and is likely to weaken further, because agitators are making a point of stirring up resentment against forest owners: their prestige is less and their failure to collect rents makes it less easy to maintain forest guards. Matters are even more difficult for the small patnidar who has no prestige and no influence except such as his personality gives him. All the owners questioned on the point were unanimous as to the difficulty in getting convictions in respect of forest offences. The causes are many: the villagers refuse to give evidence because they sympathise with the offenders: in Nayabasan under the guidance of agitators habitual offenders make a point of having standing quarrels with forest guards so as to be sure of having a plausible defence when accused of forest offences: and the courts demand an extremely high standard of proof. Major Scott, General Manager of the Midnapore Zamindari Company, expressed the opinion that what was required for the preservation of forests was better control over forest offences, including some method of dealing summarily with villagers who deliberately steal forest-produce or graze cattle in young coppice; others suggested that zamindars might be given powers to deal with offenders. But even if a few zemindars have staff which might conceivably be entrusted with such powers, the possibilities of abuse are so great that this suggestion cannot be accepted; and the Committee have been led to the opinion that the only course is to give Forest Officers power to deal with such offences on behalf of the owners of controlled forests. The two important things are power to seize forest-produce in respect of which an offence is suspected and power to compromise; the latter is effective because offenders who would fight a case desparately in court are often willing to compromise when detected on the spot. It is proposed in clause 26(*1*) that a Forest Officer or the police (not the officers of private owners) may seize suspected forest-produce; in clause 28 that the Regional Forest-officer should be responsible for deciding whether there should be a prosecution in respect of such produce; and in clause 44 that a Forest Officer empowered by notification should be able to compound. There have been inserted in the Bill, in clause 29, provisions regarding the disposal of property seized. The usual procedure already where there is Government forest is that all forest-produce in transit is accompanied by a pass and there would be no difficulty in extending this to areas where there are controlled and vested forests; the inconvenience caused is very small compared with the benefits which result to the forests. When a man is found transporting forest-produce without a pass, he is responsible for proving that there has

been no offence. The only thing new about this procedure, which finds a place in Forest Codes everywhere, would be its application to the controlled forests: and since it would assist their owners to avoid having to leave them to Government management, this novelty is thoroughly justified. But although most of the provisions in the draft Bill regarding the prevention and punishment of forest offences are adapted from the Indian Forest Act, there is one which has been borrowed from the draft Private Forest Bill which was annexed to the report of the Stephenson Committee. This is the provision in clause 24 for a collective fine of the inhabitants of any locality in the neighbourhood of a forest which is being seriously damaged with their connivance. The remarks of the Stephenson Committee on this subject were as follows:—

> "If a whole village cuts a closed forest for their own use or pasture their cattle therein, ...it is practically impossible and useless to bring home the offence to any individuals. In such cases it is practically certain that the whole village is conniving and they should be held responsible as a whole. We propose that the District Officer should be empowered to hold an enquiry, and if he is satisfied of the guilt of the community as a whole, to inflict a fine on the whole community. Collective fining is open to great objection, but in this case it appears to be the only course and we think it is justifiable. In reserved and protected forests the Forest Act gives the power to suspend the exercise of rights in such cases: a collective fine is less drastic and will probably give rise to less complaint. It may also have the effect of creating a sense of interest in the forest on the part of the village community, a matter of the very highest importance in forest conservancy."

The present Committee have been unable to evolve any other scheme which is likely to be efficacious against a general combination to exploit forests without regard for any consideration except the selfish needs of the moment: but the provision as embodied in their draft Bill is less wide than that which found a place in the draft Bill of the Stephenson Committee, because action could not be taken under it unless the offences were such as to jeopardise the conservation of the forest: in other words the provision could not be invoked when there had merely been some isolated offences. But it is not contemplated that the provision's usefulness would lie in its application: it would be useful mainly for its deterrent effect both direct and indirect. There would have to be, as well, sustained and systematic propaganda to instruct people as to the value of the forests to them and to the whole countryside. But it must be recognised that in all probability, to judge from present indications, there would be intense propaganda the other way. Agitators, in Midnapore district at any rate, have not scrupled publicly to urge people to resist or to boycott measures which privately the same agitators admit to be beneficent: and, as soon as it is realised that Government are making real attempts to check deforestation and to afforest suitable lands, men of this stamp will make it their earnest business to defeat those attempts. It is for this reason that a provision for collective fines which seemed essential in 1909 (and which was included in the first version of the Bihar and Orissa Private Forests Bill of 1925) seems even more so now in 1939.

PROBABILITY OF IMPROVEMENT OF FORESTS UNDER GOVERNMENT MANAGEMENT.

68. It may be thought that the above proposals beg the question: they assume that there will be improvement under Government management: and this assumption may be challenged. Even if in theory there would be improvement with expert management, it might be held that management by the Forest Department was not desirable. It might be held too that if there was an improvement it would be to the benefit of the owners only and not of the villagers whose rights would have to be curtailed before an improvement was possible. Critics who have attacked the policy of the Forest Department towards villagers who live near Government forests will be apt to argue that there are obvious objections to proposals to extend that policy to villagers who live near private forests in Western Bengal. It was in order to see what substance there may be in such criticisms that members of the Committee visited the private forests which have come under Government management in Dacca and Mymensingh districts. The work done in these forests had had such striking results that it merits description. The forests in question are the Araipara forests of the Atia Zamindars in Mymensingh, comprising 28,207 acres in 26 mauzas, and belonging to 42 proprietors, and those of the Bhowal Raj Court of Wards in Dacca district, comprising 31,424 acres in 82 mauzas. Up to 1925-26 when they were taken over for management as reserved forests the Araipara forests were mostly treated by their proprietors as *Bajegarh* or unclassed forest where unregulated felling was allowed and the price of timber was realised at *ghats* and toll stations only. This led to a lot of illicit extraction and to a lot of waste. No royalty was charged for any produce taken by the local villagers for their own use; and in consequence they did not hesitate to cut a whole tree when they wanted only a plough or an axe handle: the best trees were cut for sale: the trees were felled at any height convenient so that the new growth consisted merely of whippy pollard shoots from high stumps: there was very little regeneration because there was no clear-felling and because the forests were burnt in the hot weather each year to provide ashes for the fields: trees were killed by a large woody climber (Spatholobus) which should have been controlled by cutting: and so the forest-capital was gradually but systematically depleted. Villagers broke up for cultivation forest-land which after three or four years they forsook when the soil had been exhausted: and then they moved on to repeat the process in another area. Things were very much the same in the Bhowal forests. It might have been thought that the villagers who practically treated the forests as intended for their particular benefit would have suffered from the strict control which attended the change to Government management, and would have resented it: and so they did during the first few years after the change. There was at first strong organised opposition from the villagers and there was considerable difficulty in working the forests properly. In consequence the revenue from them was low during the first two years: and in the Atia forests there was, beside, very heavy expenditure during the first three on the construction of buildings for the staff and on the forest settlement necessary for ascertaining and for modifying rights. In spite of this the average annual surplus, from the dates when the forests were taken under Government management until the end of 1937-38, was in the case of the Atia forests (13 years) Rs. 19,460 against a surplus no more than Rs. 10,000 for any year previously, and in the

case of the Bhowal forests (6 years) Rs. 40,270 against an average of Rs. 32,600 for the preceding 10 years. The figures for the periods before Government assumed management exclude all charges for supervision, while those for the subsequent periods include not only supervision charges but leave and pension charges also. Naturally the surplus has been higher in recent years when good management has had time to show its effect: and it is certain that the new trees now growing up will be far more valuable than those which are being worked at present. For this there are several reasons. Proper measures of protection have given a chance to natural regeneration which is extremely good under such conditions: the coppice shoots which spring from the base of the stumps after proper low felling form their own root systems and grow extremely fast (6 feet in the first year and 20 in four): there is systematic cutting of climbers: areas left barren after clearance by squatters have been systematically stocked either by the planting of trees or by the protection of seedlings which are already in the soil. These are measures which increase the yield; and a planned felling system which avoids sudden variations in output has prevented violent fluctuations in the prices from year to year. In consequence the new crop is expected to be worth at maturity twice as much as the average for the past three years. There can be no doubt whatever as to the benefit derived by the owners of these forests from management by the Forest Department. What is more interesting still is that the villagers also are better off, in spite of the restrictions put upon their cutting of the timber and cultivating of the soil, because the forests in their improved state have given them work which has brought them money. It was a striking thing that the members of the Committee, who visited these forests with a view to seeing what were the people's grievances, were not told of them by those who gathered to give evidence: they were approached on the contrary by contractors, carters and woodcutters who spoke of the employment afforded to them by the forests. Agriculture gives little employment in those areas, because the cultivation season lasts only from the middle of May to mid-August and the harvest season is only December-January. For about eight months in the year the forests provide the villagers with extra employment, which gives them about Rs. 2 lakhs of rupees in addition to what they make by cultivation. Each villager who is a forest labourer earns between seventy and eighty rupees from work in the forests and their earnings are spent locally. In 1934 and 1935 when the crops failed owing to shortage of rain the work in the forests saved the people from acute distress. It seems to be certain that the improvement of these forests has brought to the villagers benefits far outweighing any inconvenience caused by the restrictions imposed upon them. The improvement in the forests of Western Bengal ought relatively to be no less, though the soil will never give the extremely good regeneration for which the Dacca-Mymensingh forests are notable: and the benefits which accrue to the villagers ought to be greater because the good which they derive from the forests in their present state is not very much. If conditions in the Dhalbhum forests may be taken as a guide (and they seemed very similar to those in the neighbouring Jhargram forests) the improvement consequent upon conservation will, at any rate after a few years, be vastly to the advantage of the people. In other countries control (as opposed to management) by the State has not led to discontent: it appears from a recent work by Professor R. S. Troup entitled "Forestry and State Control" (page 51) that though control in Denmark is strict there are remarkably few complaints from

landowners and this appears to be generally the case elsewhere: the limitation of the freedom of the owner is compensated by the benefit he obtains financially from properly managed woodlands and his sense of security that his forests will not be devastated by his successors in title.

EFFECT OF CONTROL ON OWNERS' PROFITS: FOREST LOANS.

69. The forests owners who gave evidence before the Committee objected almost without exception to two results which might be expected from an extension of the rotation period and from the assumption of control by Government. The first of these was the likelihood of a fall in the income from the forests during the early years of the new system, and the second was the risk that control would prevent them from cutting forest to meet emergent demands for money. As regards the possibility of a reduced yield after the introduction of control, it cannot be denied that if owners cut less often they would have less to sell in each year until sufficient time had passed for the growth of the increased crop per acre which results from a longer rotation. Mr. Benskin said in 1928 "Probably a short felling cycle of three years produces the highest actual annual return while the forest lasts": and, although in most of the forests the return on the three-year cycle is now for any given period far lower than it would have been on a seven or ten year cycle if the forest had not been damaged by felling at short intervals, the principle still holds good: if one considers results over only a few years, the short rotation gives the larger yield. Part of it is equivalent to realisation of capital of course but this is a matter of indifference to the type of owner whose improvidence has done so much to create the present situation. It has been suggested that the result of control will be such a decrease in production that there will be a rise in the price of firewood sufficient to compensate for the decreased output: but this is extremely doubtful. The forests of Chota Nagpur are still extensive and the fall in the Western Bengal yield would almost of a certainty be counterbalanced by an increased output from Chota Nagpur: there would also be increased export from the Sundarbans. On the other hand the factors which might tend to increase the income from the forests, such as the ability of the Forest Department to put the owners into touch with reliable contractors and the elimination of rings of buyers, would not produce results for some years. The fact that owners of badly managed forests would have to face some reduction in their incomes at the outset must be faced. It would not be so serious a reduction as some appear to think; for every effort would be made to prevent too abrupt a change. There are some remarks on this in paragraph 6 of the Note on the Preparation of a Working Plan printed as Appendix VII. Mr. Shebbeare also discussed in 1925 the manner in which small forests now cut every year could be brought into a longer rotation. He explained that, to begin with, each would be divided into four roughly equal blocks which would be felled over as shown in the following table, in which the entry of an "X" in a column against a particular year means that the block whose

number is given at the top of the column would be felled over in that year:—

Year.	Block I.	Block II.	Block III.	Block IV.
1st	X	X	..	..
2nd	X	X	..	..
3rd	..	..	X	..
4th	..	..	..	X
5th	X	..	..	..
6th	..	X	..	..
7th	..	..	X	..
8th	..	..	..	X

Mr. Shebbeare considered that with two years' rest block III should give about twice as much per acre as block I or II: it will be clear that there would be a reduction of yield by half in the first two years but the longer rotation even in this extreme cases should more than make up the reduction by the end of the eighth year. If the forest was under Government control the response would be quicker because regeneration would then suffer less from grazing and uncontrolled cutting by villagers. It is not likely that the eventual result of the improvement of the forests would be such an increase in the total annual output as would lead to a noticeable fall in prices. The improvement would be gradual and the forests even after improvement can probably never, owing to the loss of soil, be as thickly stocked as they were when their owners first began to exploit them. It has been suggested that forest owners would get better prices if they were kept informed of the market rates and that the Forest Department will keep them thus informed under the new system. The following figures have been put forward as showing that the middlemen are making too big a profit, part of which might be diverted to the forest owners. The cost of cutting 1,000 maunds or 40 *teks* of firewood (a "*tek*" is the English word "stack", and is a variable unit of measurement throughout the forest areas) is Rs. 7-8 at 3 annas the *tek*: the cost of extraction by carts to a station is about 4 annas a cart or Rs. 20 per 1,000 maunds: and the cost of loading into railway waggons is about Rs. 7-8. A contractor who buys the equivalent of 1,000 maunds standing in the forest would have to pay about Rs. 80 and his costs for delivery on rail would amount to Rs. 35 per 1,000 maunds, a total of Rs. 115. Freight to Calcutta would be (at 2 annas 4 pies per maund) Rs. 146: and incidental charges in Calcutta would be Rs. 8. So by the time firewood costing Rs. 80 in the forest reaches the merchant in Calcutta costs have amounted to Rs. 189, a total of Rs. 269: in Calcutta the firewood sells at Rs. 7-8 per cart load of 16 maunds or Rs. 469 per 1,000 maunds. The deduction drawn is that the middlemen (contractors and merchants) are making the difference between Rs. 469 and Rs. 269 as their profit. The argument neglects the necessity for storage at a depot for up to a year, interest on the money invested, insurance (or its equivalent; a higher profit for a greater risk), loss by theft which must be considerable, establishment charges and commission paid to agents of one sort and another: and there are at least two middlemen's profits.

It would require very careful investigation and more detailed information than the Committee have been able to obtain before the argument could be accepted that the Calcutta prices would allow for higher rates to be paid to forest owners if they held out for them. In any case it is highly unlikely that the owners would be in a position to hold out for higher rates during the early years: a man who is in urgent need of money is in a bad position to bargain. There is no escaping the conclusion that the introduction of longer rotations will mean a considerable though temporary loss of income: and it will be no consolation to the small owner to know that if a longer rotation had not been introduced he would quickly lose his whole forest and the income with it.

70. The second objection raised by owners of forests to the idea of control over rotation was that it would prevent their raising considerable sums of money in emergencies. This has been mentioned already in this report but it is sufficiently important to be repeated. The smaller owners especially regard their forests as a reserve upon which they can draw when faced with an unexpected demand such as a court decree when a suit has gone against them. One owner in Midnapore who obviously managed his forest well remarked that he would have to cut to excess very soon because a decree was to be executed against him. In Bankura owners referred to similar practices into which they had been forced by the increase in the cess. In all districts there was mention of premature cutting because rents had to be paid to superior landlords and tenants were not paying. And a few witnesses spoke of such cutting as the natural remedy for indebtedness due to extravagance. It has already been shown that the income from forests is bound to fall off when the rotation is first extended: so the need for such demands upon the forests is likely to be more pressing after the introduction of control, until an improvement has resulted in the condition of the forests. Many of the members of the Committee sympathised with these arguments and felt it harsh that men should be faced with ruin, because, in the public interest, they would be forbidden to realise their assets. In 1937 Mr. Nath, after proposing that forests taken over by Government without any obligations under section 36 of the Indian Forest Act should be made into separate estates, remarked that the owners "should of course be allowed a rebate of land revenue and cess payable by them now, proportionate to the area Government takes over, as the revenue and cess payable by them on these areas will be realised from the newly created forest estates." This was equivalent to a proposal that the realisation of revenue and cess should be postponed till they could be recovered from the profits of the forests: but the idea has been put forward that payment of revenue and cess should be excused by way of compensating forest owners for the difficulties caused to them by control as well as for those due to management by Government. This amounts to a proposal for a Government subsidy to all forest owners in Western Bengal without exception even to those who are not likely to fall into difficulties: and on this ground alone it is obviously indefensible. If a subsidy must be given it should be on as small a scale as possible and it should not be given to persons who can get along without it. But, apart from this objection, there is another even more serious: the method in which the subsidy would be given is so cumbrous as to be unworkable. Mr. Nath himself showed how difficult it would be. He proposed that the forests should be separated from the parent estates by proper survey and demarcation and "the rent assessed afresh on the basis of original assessment or on

an equitable basis if not originally assessed," because forests and *danga* lands which had then no value were not taken into account in fixing the assessment at the time of the Permanent Settlement: later he suggests as a equitable basis "a rebate of land revenue and cess proportionate to the area". This at once raises the question what would be classed as forest: there seems to be little logic in valuing the last remnants of a mismanaged forest (for all practical purposes *danga* land with a few miserable trees on it) as if it were good cultivable land: and yet this almost certainly would have to be done if the area-basis were adopted. On the other hand it would be a colossal task, and prohibitively expensive, to value all the different classes of land comprised in a *tauzi* or a *patni* in order to see what would be a fair proportion of the revenue or rent to be charged upon the forests. It would be difficult enough to do this as regards zamindars: but the patnidars were those who were most afraid of the effects of forest-control on their finances: and there would have to be legislation to force zamindars to pass on to them the benefit of the concessions made by Government. The confusion which would result would be extreme: for there is the separate account system to be reckoned with and it would be necessary to ascertain which particular co-sharer should be credited with the value of a forest. It might happen that on an acreage basis a forest which formed a part of the land under a separate account would be reckoned to be worth more than the whole separate account including the forest: and the value of similar forests in different estates or shares could vary according to the proportion which their area bore to the land included in the estate or share. Even if the calculation could be made at a cost which would not be prohibitive, the object in view would not be obtained: to be exempted each year from payment of revenue, rent, or cess would be no compensation to the owners for being prevented from raising large sums by premature sale of forest. Such exemption would secure for them a percentage of the annual yield, but what they want is liberty at any time to lay their hands on a portion of the capital. While serving no real purpose the arrangement would be resented by zamindars as striking at the foundation of the Permanent Settlement: this is recognised by Mr. Nath who dismisses the objection summarily by saying that steps should be taken to guarantee the proprietary rights of the owners in a manner which he leaves the experts on land-revenue matters to devise. It is obvious that the objection of the zamindars would be to any modification of the Permanent Settlement whatsoever because if it was once modified at all it could be modified again in other ways: and it is impossible that so serious a step could be taken when so trifling an advantage is to be expected from it. In part the objection of the owners that they must be left free to raise money from their forests would be met by the provision that there might be temporary deviations from the working plan: but this would not be sufficient to dispose of the difficulty. The solution that has been proposed in clause 6 of the draft Bill is the grant of Forest Loans. The idea is that if a forest owner found himself hard pressed for funds, which but for control or Government management he would have raised by the sale of forest-produce, he would be allowed, on the recommendation of the Appellate Committee, to apply for a loan from Government. Normally this would be given him only to tide over the period between the introduction of control and the time when the forest became capable of the improved yield which would result from Government management; and it would be given on the security of the forest. The Appellate Committee would

therefore normally give a hearing to the Regional Forest Officer on at least these two points and on the question of the period within which the loan ought to be repaid. There would be no speculative element in the transaction so far as Government were concerned except that clearly they could not sell standing forest immediately to cover the amount of the loan, if the owner defaulted: the recovery would as a rule be by book debit when the forest was under Government management, and if the owner of a controlled forest defaulted in payment of instalments Government could safeguard their interests by taking over the management of the forest. The loans would be advanced by the Collector of the District as if they were Land Improvement Loans: and the total of the loans given each year would be limited by the Budget provision made. There would be sufficient difficulty about getting such loans to discourage people who might wish to use them as a substitute for a bank account, but the system would to a great extent meet the objections put forward by the small owners to the imposition of control on forest management. At no time would owners again be in a position to realise part of the capital value of their forests: but they would get so much larger an income after some years that they could afford to set part aside for building up a reserve fund which would serve the same purpose.

FOREST CONSERVATION CESS.

71. In 1909 the Stephenson Committee made the following comment regarding the necessity for Government expenditure on the conservation of forests in Chota Nagpur:—

"The measures proposed will involve expenditure on demarcation and the pay of the Forest Officers and this must in the initial stages be borne by Government. It might be equitable to make the proprietor and the users pay for their own protection but it would not be politic; the measures would have no chance of being accepted by the people if they involved out of pocket expense with no immediate return. Government is approaching the question from the point of view of the community at large and these interests are important enough to justify the charging of this expenditure to the profits of the Forest Department. At the same time, when the benefits of preservation become apparent, it is fair that the recurring charges should be met out of the profits for which the administration is responsible".

This statement of the case is as true now as when it was written. It is certain that if an attempt was made to enforce payment for forest improvement before the improvement became manifest it would be highly unpopular throughout the province: the Committee therefore are strongly of opinion that it will be necessary for Government at the outset to bear the cost of the Regional Forest-officers and of their staff. There would have to be two Regional Forest-officers for Western Bengal, one dealing with Midnapore and with that part of Bankura which lies to the south of the river Dwarkeswar and the other with the rest of Bankura, Burdwan and Birbhum. Under each of these there would have to be two Range Officers: these would collect the data for the preparation of working plans for vested forests and for the check of those for the controlled forests, would make the inspections

necessary for seeing that there was no unauthorised departure from them, would deal with the prosecution and the compounding of forest offences, and would supervise afforestation. Under each of the Range Officers there would have to be two Beat Officers, who would deal with the matters entrusted to Range Officers except that they would have no power to compound offences. In addition there would be two clerks and six peons or orderlies under each Regional Forest-officer. The latter would be responsible for the general administration of the Forest Region, under the control of the Conservator of Forests, and for the performance of all the functions which it is proposed in the Bill to assign to him including in particular the adoption of suitable working plans for every controlled and vested forest in his region. The total cost has been worked out in Appendix X. For each Regional Forest-officer the initial capital expenditure would be Rs. 18,450; and the recurring expenditure would be for staff maintenance and contingencies Rs. 27,150, and for leave and pensionary charges Rs. 3,000, or Rs. 30,150 per annum. Thus the total expenditure for the two Regional Forest-officers would be Rs. 36,900 capital and Rs. 60,300 recurring or, say, Rs. 37,000 and Rs. 60,000. The temptation to reduce the cost by employing temporary staff on lower pay would have to be resisted: the interests involved are too important: and if the work is taken up at all it should be without any reservations and without any facilities for dropping it before results are obtained. The expenditure would fall on Government during the first 10 years only, during which control would lead to reduced incomes: after the tenth year the improvement in the condition of the forests ought to have led to an increase in the income from them, and it would then, in the opinion of the Committee, be fair to demand a return from the owners for the expert advice of which they would have had and would continue to have the benefit. The proposal embodied in clause 11 of the draft Bill is that the cess should be charged on an acreage basis. This appears preferable to the only alternative at all practicable, which is to charge a cess on the despatches by rail: the latter would work unfairly because in Bankura, Burdwan and Birbhum the greater part of the forest produce is not despatched by rail at all, and if the cess were imposed on such despatches it would be paid mainly by the owners of the large forests of Midnapore which will benefit least (though materially) from the introduction of control. To charge a cess on forest produce transported by road does not seem practicable. The objection to charging on an acreage basis is that all forest land is not equally productive and the incidence of the cess would be heavier on the less productive land. This however is, in a sense, as it should be: an owner may reasonably claim to profit by having kept his forest in good condition: and so long as care was taken not to assess as forest all land recorded as such (because some might have ceased to bear trees), no harm would result: the details of assessment would be left to rules and the necessary provision could be made in these, when the time came, in the light of ten years' experience. The proposal that the amount raised by way of cess should be no more than is required to meet the cost of the Regional Forest-officer and of his staff would be a safeguard against any temptation to impose the cess on land that was only technically forest. If all the forests in the Western Bengal districts paid cess the incidence would be something like 1 anna or 1½ annas per acre per annum. It should be observed that the staff for this work does not exist at present and it would probably be three years at least before it could be recruited and trained.

EXPENDITURE ON VESTED FORESTS.

72. As regards vested forests the proposal is that their maintenance and improvement should be financed by Government. Any loss on the working of a forest in any year would be debited against the forest in the accounts and be recovered from future profits. The difficulty to be avoided if possible is a deficit in the initial years, such as handicapped the success of the work in the Araipara Forests. That deficit was due chiefly to the decision that the capital expenditure incurred in the first years of management should be met entirely from revenue: this is a method which no private individual and no business concern would dream of following: and its adoption would be most unfair to the forest owners. They could with reason complain if they were left for some years without any income whatsoever from their forests because forest officers thought various expensive improvements to be advisable and Government decided to follow unorthodox methods of finance. In Bihar, it will be remembered, under the agreement system Government cancel any sums outstanding at the end of each year during the first ten or eleven years: and it is in comparison a very modest suggestion that is now being made for an advance of the necessary working capital in the first few years of Government management. How much would be required it is impossible to say: the object would be to avoid taking more forests under Government management than was absolutely necessary, and to frame an estimate would be guess work. Such expenditure in effect would be another form of loan to forest owners; and the amount to be invested in each case would have to be considered in the light of the existing condition and of the possibilities of each forest after taking into account the amount of any loan which the owner would be likely to want for his personal needs. It is necessary in this connection also to sound a note of warning as to the danger of economising on staff. The forest owners generally have made this mistake and many of them have expressed dislike of Government's policy of having high overhead expenses: it is however the only policy which can make forests pay because honesty and science are both essential and both cost money. It would cause a bad set-back to the whole scheme of forest conservation if the management by Government of any forests proved a failure: and therefore any requests by owners to have their forests run by a cheap agency like a temporary staff on fixed pay and with no pensions should be resisted as dangerous. The Committee propose that, except in the form of Forest Cess, nothing should be charged against vested forests for the work done in connection with them by the Regional Forest-officer or by any of his staff except such as may be entertained specially on their account. It may be mentioned here that there can be no estimate of the cost of afforestation: Mr. Nath prepared one but it is based on numerous assumptions and for our present purposes is useless. An estimate cannot be made till the results of experiments are known.

73. It has been mentioned in paragraph 25 of this report that the deterioration of the larger rivers of Western Bengal is due mainly to the deterioration of forests in Chota Nagpur: and the Committee consider it necessary to record their opinion that steps should be taken by the Government of Bengal to secure the co-operation of the Government of Bihar in dealing with the problem. The general principle that forests in any province should be managed in such a way as not to prejudice the interests of any other province was recognised in the

resolution of the Forestry Conference at Delhi in December 1937. This resolution recommended that large scale deforestation should not be approved in any province except after full consideration by the Ministers and after consultation with any other province likely to be affected. Clearly the resolution did not take into account the difficulties which must arise when the forests are private forests, like the majority of those in Chota Nagpur. The Committee have already pointed out that the Bihar Government have given a lead to Bengal in this matter but they venture to think that the problem in Chota Nagpur is too large to be solved unless steps are taken there on the lines recommended in this report.

74. The Committee record their appreciation of the work done by their Secretary, Mr. Ahmad, and of the assistance given and hospitality shown to them by Collectors and their officers in the districts visited. They wish also to express their thanks to Major J. D. Scott of the Midnapore Zamindari Company, Babu Jagendra Nath Sahas Roy of Lalgarh, Babu Narendra Nath Sinha Sahas Roy of Ramgarh, Babu Narasingha Malla Deb of Jhargram, the Maharaja of Mayurbhanj and the Union Board of Medinipur in Bankura for their hospitality and for their help.

H. P. V. TOWNEND.

SOSHI KANTA ACHARJYA CHOUDHURY (MAHARAJA).

J. N. BASU.

U. C. MAHTAB.

NAZIRUDDIN AHMAD.

RAI HARENDRA NATH CHAUDHURI.*

BANKU BEHARI MANDAL.

ABDUL BARI.

BIRAT CHANDRA MANDAL.

SYED MOSTAGAWSAL HAQUE.

G. W. WOODGATES.

C. E. SIMMONS.

B. R. SEN.

Y. S. AHMAD.

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* Subject to a note of dissent which is printed on pages 103-108.

ANNEXURE.

THE BENGAL PRIVATE FORESTS BILL, 1939.

A

BILL

to provide for the conservation of forests and for the afforestation of waste lands in Bengal, where such forests or lands are not the property of the Government.

WHEREAS it is expedient to empower the Government to provide for the conservation of forests in Bengal which are not the property of the Government; Preamble.

AND WHEREAS it is also expedient in certain cases to provide facilities for, or to empower the Government to direct, the afforestation of lands which are not the property of the Government;

It is hereby enacted as follows:—

CHAPTER I.

PRELIMINARY.

1. (*1*) This Act may be called the Bengal Private Forests Act, 1939. Short title and extent.

(*2*) It applies to the districts of Bankura, Birbhum, Burdwan and Midnapore, and to any areas in any other districts to which, after calling for and considering objections in the prescribed manner, the Government may from time to time by notification extend it.

2. In this Act, unless there is anything repugnant in the subject or context,— Definitions.

(*1*) "Forest" includes any land recorded as forest in a record of rights prepared under the Bengal Tenancy Act and any land deemed to be forest under the provisions of Section 8, or under Section 9;

(*2*) "Forest-officer" means any person whom the Provincial Government or any officer empowered by the Provincial Government in this behalf, may appoint to carry out all or any of the purposes of this Act or to do anything required by this Act or any rule made thereunder to be done by a Forest-officer;

(*3*) "Regional Forest-officer" means a Forest-officer appointed as such by a notification for a notified area;

(*4*) "Notification" means a notification published in the *Calcutta Gazette;*

(*5*) "Appellate Committee" means a committee of three members appointed to hear appeals under this Act, of which the Chairman shall be the Collector of the district and the other two members shall respectively be a Forest-officer and an owner of a private forest who shall be selected in the prescribed manner from a panel appointed for a notified area;

(*6*) "Conservation" of a forest includes such measures as are necessary in the opinion of the Regional Forest-officer for the prevention or remedying of soil erosion, floods and land slides;

(*7*) "Notified area" means an area specified in a notification under Section 3 of this Act;

(*8*) "Forest Settlement-officer" means an officer of the Government, who shall not ordinarily hold any forest-office except that of Forest Settlement-officer, or a Board of not more than three such officers, of whom not more than one shall hold any forest-office except as aforesaid, appointed by the Governor in Council to inquire into and determine the existence, nature and extent of any rights alleged to exist in favour of any person in or over any land comprised within a notified area, or in or over any forest-produce, and to deal with the same as provided in this Act;

(*9*) "Forest-offence" means an offence punishable under this Act or under any rule made thereunder;

(*10*) "Forest-produce" includes—

(*a*) the following when found in, or brought from, a forest or not, that is to say:—
timber, charcoal, caoutchouc, catechu, wood-oil, resin, natural varnish, bark, lac, mahua flowers, mahua seeds and myrabolams, and

(*b*) the following when found in, or brought from, a forest, that is to say:—

(*i*) trees and leaves, flowers and fruits, and all other parts or produce not hereinbefore mentioned, of trees,

(*ii*) plants not being trees (including grass, creepers, reeds and moss), and all parts or produce of such plants,

(*iii*) wild animals and skins, tusks, horns, bones, silk, cocoons, honey and wax, and all other parts or produce of animals, and

(*iv*) peat, surface soil, rock and minerals (including limestone, laterite, mineral oils, and all products of mines or quarries);

(*11*) "Timber" includes trees when they have fallen or have been felled, and all wood whether cut up or fashioned or hollowed out for any purpose or not;

(*12*) "Tree" includes palms, bamboos, stumps, brush-wood and canes;

(*13*) "Cattle" includes elephants, camels, buffaloes, horses, mares, geldings, ponies, colts, fillies, mules, asses, pigs, rams, ewes, sheep, lambs, goats and kids;

(*14*) "Owner" means the proprietor and includes a Court of Wards in respect of a property under the superintendence or charge of such Court, and also any transferee or other successor in interest of such property and any receiver appointed by a competent Court;

(*15*) "River" includes any stream, canal, creek or other channel, natural or artificial;

(*16*) "Controlled forest" means a forest in respect of which a working plan has been approved under Section 3;

(*17*) "Vested forest" means a forest of which the control has been vested in a Regional Forest-officer by a notification under sub-section (*2*) of Section 4, Section 5 or under Section 9;

(*18*) "Working Plan" means a written scheme of management, aiming at a continuity of policy, controlling the treatment of a forest; and

(*19*) "Year" means a year beginning on the first day of April.

(*20*) "Private Forest" means a forest which is not the property of Government.

CHAPTER II.

Conservation and Afforestation.

Notified area.

3. (*1*) The Government may by notification direct that any or every owner of a private forest, situated within an area, hereinafter called a notified area, to be specified in the notification shall in the prescribed manner prepare and submit to the Regional Forest-officer a working plan for the conservation of such forest;

(*2*) If such forest-owner does not submit a working plan for any forest within a period fixed by the notification, or if the owner expresses his unwillingness or inability to prepare a working plan, the Regional Forest-officer may prepare a working plan for it;

(*3*) If any working plan submitted by an owner under sub-section (*1*) is not calculated in the opinion of the Regional Forest-officer to secure the conservation of a forest, he shall by written order modify it in such manner as he may deem fit, or substitute another working plan for it, and shall cause a copy of his order to be served upon the owner of such forest;

(*4*) Such owner may within sixty days of the date of an order made under sub-section (*3*) appeal to the Appellate Committee, whose decision setting aside, modifying or confirming the order shall be final;

(*5*) A working plan shall be deemed to be an approved working plan for the purpose of this Act, when it has been certified as such by the Regional Forest-officer or the Chairman of the Appellate Committee:

Provided always that the Regional Forest-officer shall not so certify any working plan that he has modified or substituted under sub-section (*3*) until the expiry of sixty days from the date of his order under that subsection;

(*6*) A copy of an approved working plan shall be supplied by the Regional Forest-officer to the owner of the forest to which it relates;

(*7*) At any time after five years from the date of approval a Regional Forest-officer may modify an approved working plan in such manner as he considers necessary, and the provisions of sub-sections (*4*), (*5*) and (*6*) shall apply to any plan modified:

Provided that nothing in this sub-section shall prevent the owner, after the expiry of five years, from requesting the Regional Forest-officer, in writing, to revise the working plan, and if the Regional Forest-officer does not see fit so to revise the working plan the owner may appeal to the Appellate Committee whose decision in the matter shall be final.

Penalty for violating the working plan.

4. (*1*) If, after a working plan for any forest has been approved, the owner thereof contravenes any of the prescriptions of such plan, he shall, on conviction by a Magistrate, be liable in respect of each instance of such neglect or failure to a fine, which may extend to rupees five hundred or to treble the value of any forest produce that may have been removed from such forest in contravention of the prescriptions of the working plan whichever is greater.

(2) Within sixty days of a second or subsequent conviction under sub-section (1) the Regional Forest-officer may by written notice call upon the owner to show cause before the Appellate Committee within a reasonable period to be specified in the notice, why action should not be taken under this sub-section; and if the Appellate Committee after due consideration of the cause, if any, thus shown, so recommends, the Government, by a notification, may direct the control of such forest to be vested in a Regional Forest-officer for such period as may appear to the Committee necessary for its conservation.

(3) Nothing in this section shall render any owner liable to conviction under sub-section (1) for any deviation sanctioned by competent authority from the prescriptions of an approved working plan.

Vesting of forest in a Regional Forest-officer.

5. (1) Notwithstanding the provisions of Sections 3 and 4 of this Act, if the Government is satisfied that the conservation of any forest in a notified area cannot safely be left to the owner it may by or notification direct the control of such forest to be vested in a Regional Forest-officer for a period to be stated in the notification:

Provided always that such notification shall not be published until—

(a) the Regional Forest-officer has by a written notice called upon the owner to show cause before the Appellate Committee, within a reasonable period to be stated in the notice, why the control of his forest should not so be vested, and

(b) the Appellate Committee, after considering such cause, if any, thus shown and any evidence that the owner may have produced, has submitted to the Government a recommendation that such notification should be published.

(2) The reasons for which the Government considers it unsafe to leave the conservation of a forest to its owner shall be stated in the notification under sub-section (1).

Forest loans.

6. (1) Subject to such rules as may be made under Section 52 loans may be made under this Act, by such officer as may from time to time be empowered in this behalf by the Government, to any owner of a controlled forest or of a vested forest who in the opinion of the Appellate Committee is likely to suffer unduly owing to any temporary reduction of his income which may result from the adoption of a working plan.

(*2*) An application for such a loan shall be made in the prescribed manner to the Appellate Committee and shall state the following particulars:—

(*a*) the amount of the loan required,

(*b*) the reasons for which it is necessary, and

(*c*) the period for which it is required.

(*3*) After considering in the prescribed manner the application and any evidence that may be produced in support thereof, the Appellate Committee shall state in writing its opinion whether a loan should be given or not, and if it recommends a loan, shall forward the application to such officer with its opinion which shall state the reasons why a loan should be given with the following particulars:—

(*a*) its amount and the rate of interest that should be charged,

(*b*) the instalments in which it should be advanced, and

(*c*) the period after which and the instalments in which it should be repaid.

Amalgamation of several vested forests under one working plan.

7. (*1*) If a Regional Forest-officer is of the opinion that it is impossible otherwise to secure the conservation of all or any two or more forests, belonging to different owners, of which the control has been vested in him by a notification under sub-section (*2*) of Section 4 or under Section 5, he may record an order that such forests shall be managed under one working plan as if they all belonged to one owner, and shall cause a copy of such order to be served on the owner of each such forest.

(*2*) The Regional Forest-officer may at any time by written order rescind or modify an order passed by him under sub-section (*1*).

(*3*) Any owner or other person interested may within six weeks of an order passed under sub-section (*1*) or (*2*) appeal against it to the Appellate Committee, whose decision setting aside, modifying or confirming such order shall be final.

Afforestation of land adjoining a forest.

8. (*1*) If, from a report of a Regional Forest-officer, the Government is satisfied that any land adjoining a controlled or vested forest has not been cultivated in at least two of the three years immediately preceding the year in which such report is prepared and that such land is suitable for afforestation, it may by a notice of which a copy shall be served upon the person entitled to cultivate such land, announce its intention to declare such land liable to be made over to the owner of such forest for afforestation.

(*2*) On the expiry of a period to be mentioned in the notice the Government may by notification declare such land liable to be made over to such owner for afforestation, and shall forthwith appoint a Forest Settlement-officer to determine, subject to any rules which may be made under this Act, by an order in writing—

(*a*) what rights in or over such land shall be extinguished,

(*b*) what compensation shall be payable to any person whose rights will be extinguished, and

(*c*) what rent, if any, shall be payable by the owner of the forest to any landlord of such land:

Provided always that such notification shall not be published until after the issue of a notice, calling upon the owner to show cause before the Appellate Committee within a reasonable period, to be stated in the notice, why the notification should not be published; and until his objections, if any, and any evidence he may produce before the Appellate Committee have been considered by the Government.

(*3*) When compensation as determined under sub-section (*2*) has been paid by the owner of the forest, the land shall be made over to such owner and all rights specified by the officer under clause (*a*) of sub-section (*2*) shall therefrom be extinguished.

(*4*) When land is made over under sub-section (*3*) it shall be deemed to be a forest in a notified area.

Afforestation of other land.

9. (*1*) If it appears from the report of a Regional Forest-officer that any waste land which has not been cultivated for ten years is suitable for afforestation and that the owner is unwilling or unable to cultivate it, either with agricultural crops or with grass to the satisfaction of such officer, or to afforest it. the Government may by a notification direct the control of such land to be vested in a Regional Forest-officer for the purpose of afforestation for a period to be stated in the notification:

Provided that no such notification shall be published until a notice has been issued in the prescribed manner calling upon the owner of such land and any other person interested therein to show cause before the Appellate Committee within a reasonable period to be specified in the notice, why the notification should not be published and until any cause thus shown and any evidence that may have been produced in support of the same before the Appellate Committee have been considered by the Government.

(*2*) Any land in respect of which a notification has been published under sub-section (*1*) shall be deemed to be a vested forest for the purposes of this Act.

(*3*) When a notification has been issued under sub-section (*1*) the Government shall appoint a Forest Settlement-officer to inquire what rights exist in or over such land, other than the rights of ownership, and to determine which of such rights, if any, shall be extinguished or modified and what compensation, if any, shall be payable in respect of such rights.

(*4*) When all expenses incurred by the Government for the afforestation of any such land have been recouped, the profits resulting from such afforestation shall, so long as the control of Government continues, be divided between the Government and the owner of the land in such manner as may be prescribed by Government.

Determination of cost of management of vested forest and distribution of net profit.

10. (*1*) The cost of any extra staff required for the management of a vested forest in each year shall be determined in the prescribed manner by the Regional Forest-officer and shall be recovered by him in that year or in subsequent years from the sale of the produce of such forest.

(*2*) The cost of the operations of any Forest Settlement-officer and such part of the cost of a Regional Forest-officer and of his staff as is proportionate to the work done by them in connection with the management of a vested forest shall be included in the cost of management.

(*3*) Any amount due in respect of a loan made under Section 6 to the owner of a vested forest shall be included in the cost of management of such forest.

(*4*) Until otherwise determined by a competent court, the respective shares of the owners of such forest shall be determined by a Forest Settlement-officer in the prescribed manner; and thereafter, any profits in respect of each such forest, which shall be determined in the prescribed manner, shall be distributed among the various owners thereof in accordance with such determination.

(*5*) In each year the Regional Forest-officer shall record in a written statement the amount with which each vested forest shall be charged and any amount which shall be paid in respect of the net profit and shall cause a copy of such statement to be served on the owner of each such forest.

Cess.

11. (*1*) The Government may with effect from the end of the one hundred and twentieth month after a notification under Section 3 impose on an acreage basis, in the prescribed manner, a cess on the forests within a notified area.

(*2*) Such cess shall be so calculated as to yield a sum not greater than is sufficient to meet the cost of the Regional Forest-officer and of his staff and the cost incurred in connection with their work which shall be determined in the prescribed manner.

(*3*) If the Regional Forest-officer or his staff does any work in connection with a Government forest, a proportionate deduction shall be made from the cost of such Regional Forest-officer and of his staff before cess is calculated under sub-section (*2*).

(*4*) Such cess shall be recoverable as a public demand.

Release of vested fores to the owner.

12. (*1*) If the owner of a vested forest satisfies the Appellate Committee—

(*a*) at any time after the expiry of fifteen years from the date of notification, that

(*i*) the control of such forest may be restored to him without undue risk of detriment to its conservation, and

(*ii*) the cost of its management as determined under the provisions of sub-section (*1*) of Section 10 has been recovered in full; or

(*b*) at any time after the expiry of thirty years from the date of such notification, the cost of management as so determined, of such forest has been recovered;

the Appellate Committee shall pass an order that with effect from a date, therein to be specified, the control of such forest shall cease to be vested in the Regional Forest-officer:

Provided that such order shall not take effect till a working plan has been approved for such forest under Section 3: and

Provided further that no such order shall be passed regarding a forest in respect of which there subsists an order passed under sub-section (*1*) of Section 7, unless the owners of all the forests, in respect of which the order under the said sub-section was passed,, have satisfied the Appellate Committee that there will be no undue risk of detriment to the conservation of any of such forests, if their control ceases to be vested in the Regional Forest-officer.

(*2*) The fact that the control of any forest has ceased to be vested in a Regional Forest-officer shall not operate to revive any right which may have been extinguished or modified by a proclamation under Section 22.

CHAPTER III.

OF RIGHTS IN FORESTS.

Control and demarcation of vested forest.

13. When a notification has been published in respect of any forest under sub-section (*2*) of Section 4 or under Section 5 or 9, the control of such forest shall be vested in the Regional Forest-officer, who shall forthwith proceed to demarcate it.

Appointment of Forest Settlement-officer.

14. (*1*) A Forest Settlement-officer shall be appointed by the Government in respect of any forest of which the control is vested in a Regional Forest-officer by a notification under this Act, and may be appointed in respect of any controlled forest on the application of its owner.

(*2*) Such appointment shall be made by a notification specifying as nearly as may be possible the situation and limits of such forest.

Bar of accrual of rights.
(I. F. A. 5.)

15. After the issue of a notification under Section 14, no right shall be acquired in or over the land comprised in such notification, except by succession or under grant or contract in writing made or entered into, with the previous sanction of Government, by or on behalf of the owner or some person in whom such right was vested when the notification was issued; and no fresh clearings for cultivation or for any other purpose, and cutting, conversion or removal of timber or the collection, manufacture or removal of other forest-produce, shall be allowed in such area except in accordance with such rules, if any, as may be made by the Government under this Act.

Proclamation by Forest Settlement-officer.

16. (*1*) The Forest Settlement-officer shall publish in Bengali in the neighbourhood of the forest a proclamation—

(*a*) specifying, as early as possible, its situation and limits;

(*b*) explaining the measures proposed for, and the consequences of, the conservation of such forest; and

(*c*) requiring every person who claims any right, other than a right of ownership, over such forest or over forest-produce from it, to give to such Forest Settlement-officer, within a period of not less than three months to be stated in the proclamation, particulars, either in writing or by word of mouth, of such right and the amount and nature of the compensatoin if any claimed in respect thereof.

(*2*) The Forest Settlement-officer shall record in writing all claims made by word of mouth under clause (*c*).

Inquiry by Forest Settlement-officer.

17. (*1*) The Forest Settlement-officer shall at some convenient place inquire into the existence of any rights which are claimed under sub-section (*1*) of Section 16 or which may be ascertained by him from any other source.

(*2*) The Forest Settlement-officer shall give a hearing to the Regional Forest-officer or an officer authorised by him regarding the advisability of modifying or extinguishing any right in the interests of the conservation of the forest.

Powers of Forest Settlement-officer. (I. F. A. 8.)

18. For the purpose of such inquiry, the Forest Settlement-officer may exercise the following powers, that is to say:—

(*a*) power to enter, by himself or any officer authorised by him for the purpose, upon any land, and to survey, demarcate and make a map of the same; and

(*b*) the powers of a Civil Court in the trial of suits.

Specification and modification of rights.

19. (*1*) After completion of the inquiry under Section 17, the Forest Settlement-officer shall, by an order in writing,—

(*a*) record the nature of the rights existing at the time of the notification under Section 14; and

(*b*) direct the modification or extinction of any such right, other than a right of ownership, in the interests of the conservation of the forest.

(*2*) When the Forest Settlement-officer directs the modification or extinction of any right he shall, unless the person affected has come to an agreement in respect thereof, determine what compensation shall be awarded to such person.

Appeals. (I. F. A. 18.)

20. (*1*) An appeal may be made, within 3 months from the date of an order under Section 19, by an owner of a forest or by a Regional Forest-officer or by any person who has given particulars of his claims under sub-section (*1*) of Section 16, to the Collector of the district.

(*2*) Such appeal shall be made by a petition in writing and shall be heard in the manner prescribed for the time being for the hearing of appeals in matters relating to land revenue.

(*3*) The order of the Collector on such appeal shall, subject only to revision by the Government, be final.

Pleaders. (I. F. A. 19.)

21. The Government, or any person who has made a claim under this Act, may appoint any person to appear, plead and act on its or his behalf before the Forest Settlement-officer, or any appellate authority, in the course of any inquiry or appeal under this Act.

Extinction of rights.

22. (*1*) When the time for appeals against an order under Section 19 has elapsed and when all appeals under Section 20 have been disposed of, the Forest Settlement-officer shall issue a proclamation declaring what rights may be exercised in respect of the forest.

(*2*) A Bengali translation of such proclamation shall be published in the neighbourhood of the forest.

(*3*) With effect from the date of such proclamation all rights not specified therein in connection with the forest shall be extinguished.

CHAPTER IV.

Penalties and Procedure.

Penalties for breach of rules. (I. F. A. 33.)

23. (*1*) Any person who—

(*a*) fells, girdles, lops, taps, or burns any tree or strips off the bark or leaves from or otherwise damages, any tree;

(*b*) quarries any stone, or burns any lime or charcoal, or collects, subjects to any manufacturing process, or removes any forest-produce;

(*c*) breaks up or clears for cultivation or any other purpose any land in a forest;

(*d*) sets fire to a forest, or kindles a fire without taking all reasonable precautions to prevent its spreading to any portion of a forest;

(*e*) permits cattle to damage any trees in a forest;

shall be punishable with imprisonment for a term which may extend to six months, or with fine which may extend to five hundred rupees, or with both.

(*2*) Any person containing any rule under this Act, for the contravention of which no special penalty is provided, shall be punishable with imprisonment for a term which may extend to one month, or fine which may extend to five hundred rupees, or both.

Collective fine of the inhabitants. (B. A. 17).

24. (*1*) If it is proved to the satisfaction of the District Magistrate that in any vested forest—

(*i*) any cattle have been permitted to trespass;

(*ii*) any trees have been felled, girdled, lopped, tapped, burnt or otherwise damaged;

(*iii*) any other forest-produce has been burnt or removed; or

(*iv*) any land has been broken up for any purpose;

otherwise than in exercise of a right, in such a manner as to jeopardise in any degree the conservation of such forest, and if he is satisfied that the inhabitants of any locality have connived thereat, he may impose on such inhabitants a fine which may extend to five hundred rupees or three times the value of any produce damaged, whichever is greater, and may, after such further enquiry, as he deems necessary, apportion such fine among such inhabitants.

(*2*) Every appointment made under sub-section (*1*) shall be subject to revision by the Commissioner whose decision shall be final.

Nothing to prohibit acts done in certain cases. (I. F. A. 34.)

25. No act shall be an offence for the purposes of Section 23 if it is done—

(*a*) in the exercise of any right in or over such forest, or

(*b*) in respect of a vested forest, with the permission in writing of a Forest-officer, or

(*c*) in respect of a controlled forest, with the permission in writing of the owner thereof or of his agent, or

(*d*) in accordance with rules made under Section 50.

Seizure of property liable to confiscation. (I. F. A. 52.

26. (*1*) When there is reason to believe that a forest-offence has been committed in respect of any forest-produce, such produce, together with all tools, boats, carts or cattle used in committing any such offence, may be seized by any Forest-officer or Police-officer.

(*2*) Every officer seizing any property under this section shall place on such property a mark indicating that the same has been so seized, and shall, as soon as may be, make a report of such seizure to the Magistrate having jurisdiction to try the offence on account of which the seizure has been made:

Provided that, when the offender is unknown, it shall be sufficient if the officer makes, as soon as may be, a report of the circumstances to his official superior.

Power to release property seized under Section 26.
(I. F. A. 53.)

27. Any Forest-officer of a rank not inferior to that of a Ranger, or any Police-officer of a rank not inferior to that of a Sub-Inspector, who, or whose subordinate, has seized any tools, boats, carts or cattle under Section 26, may release the same on execution by the owner thereof of a bond for the production of the property so released, if and when so required, before the Magistrate having jurisdiction to try the offence on account of which the seizure has been made.

Procedure thereupon.
(I. F. A. 54.)

28. The Regional Forest-officer may cause information to be given to a Magistrate regarding any offence which he had reason to believe to have been committed in respect of any forest-produce; and upon receipt of such information, the Magistrate shall, with all convenient despatch, take such measures as may be necessary for the arrest and trial of the offender and the disposal of the property according to law.

Notice to claimants of seized forest-produce.

29. (*1*) If a Regional Forest-officer has not caused information to be given to a Magistrate under Section 28 in respect of any forest-produce seized under sub-section (*1*) of Section 26, he shall, if there is any doubt as to the forest from which such produce has been derived, cause a notice to be published in such manner as may be prescribed containing a description of such produce and requiring any person who may claim the same to present a written statement of his claim to him within a period of not less than one month from the date of such notice.

(*2*) If only one such statement is presented in respect of any forest-produce, the Regional Forest-officer shall, after making such inquiry as he thinks fit and recording his reasons in writing, either reject the claim or deliver the produce to the claimant.

(*3*) If more than one such statement is presented, the Regional Forest-officer, after making such inquiry as he thinks fit and recording his reasons in writing, either may deliver the forest-produce to any of such persons whom he deems entitled thereto or may refer the claimants to the Civil Courts and retain such produce pending receipt of an order from any such court for its disposal.

(*4*) Any person whose claim has been rejected under this section may, within three months from the date of such rejection, institute a suit to recover possession of the forest-produce claimed by him; but no person shall recover any compensation or costs against the Government, or against any Forest-officer, on account of such rejection, or on account of the detention or removal of any forest-produce, or the delivery thereof to any other person under this section.

(5) No such forest-produce shall be subject to process of any Civil, Criminal or Revenue Court until it has been delivered, or a suit has been brought, as provided in this section.

Disposal of unclaimed forest-produce.

30. If no statement is presented in respect of any such forest-produce under sub-section (2) or (3) of Section 29 or if a person, whose claim made under that section has been rejected, omits to institute a suit under sub-section (4) thereof, the ownership of such forest-produce shall vest in the Government free from all encumbrances, or, when such forest-produce has been delivered to another person under sub-section (3) thereof, in such other person free from all encumbrances not created by him.

Disposal of property seized under Secton 26.
(I. F. A. 55.)

31. (1) Any forest-produce in respect of which a forest-offence has been committed shall be handed over to the owner of the forest from which it was derived:

Provided that if it is not known from what forest such produce was derived, it shall be confiscated, and all tools, boats, carts and cattle used in committing any forest-offence shall be liable to confiscation.

(2) Such confiscation may be in addition to any other punishment prescribed for such offence.

Disposal of seized property on conclusion of trial.
(I. F. A. 56.)

32. When the trial of any forest-offence is concluded, any forest-produce in respect of which such offence has been committed shall, if it has been confiscated, be taken charge of by a Forest-officer, and, in any other case, may be disposed of in such manner as the Court may direct.

Procedure when offender cannot be found.
(I. F. A. 57.)

33. When the offender cannot be found, the Magistrate may, if he finds that an offence has been committed, order the property in respect of which the offence has been committed to be confiscated and taken charge of by the Regional Forest-officer, or to be made over to the person whom the Magistrate deems to be entitled to the same:

Provided that no such order shall be made until the expiration of one month from the date of seizing such property, or without hearing the person, if any, claiming any right thereto, and the evidence, if any, which he may produce in support of his claim.

Procedure as to perishable property seized under Section 26.
(I. F. A. 58.)

34. The Magistrate may, notwithstanding anything hereinbefore contained, direct the sale of any property seized under Section 26 and subject to speedy and natural decay, and may deal with the proceeds as he would have dealt with such property if it had not been sold.

Appeal from orders under Section 31, Section 32 or Section 33.
(I. F. A. 59.)

35. The officer who made the seizure under Section 26, or any of his official superiors, or any person claiming to be interested in the property so seized, may, within one month from the date of any order passed under Section 31, Section 32 or Section 33, appeal therefrom to the Court to which orders made by such Magistrate are ordinarily appealable, and the order passed on such appeal shall be final.

Property when to vest in Government.
(I. F. A. 60.)

36. When an order for the confiscation of any property has been passed under Section 31 or Section 33, as the case may be, and the period limited by Section 35 for an appeal from such order has elapsed, and no such appeal has been preferred, or when on such an appeal being preferred, the Appellate Court confirms such order in respect of the whole or a portion of such property, such property or such portion thereof, as the case may be, shall vest in the Government free from all encumbrances.

Saving of power to release property seized.
(I. F. A. 61.)

37. Nothing hereinbefore contained shall be deemed to prevent any officer empowered in this behalf by the Government from directing at any time the immediate release of any property seized under Section 26.

Punishment for wrongful seizure.
(I. F. A. 62.)

38. Any Forest-officer or Police-officer who vexatiously and unnecessarily seizes any property on pretence of seizing property liable to confiscation under this Act shall be punishable with imprisonment for a term which may extend to six months, or with fine which may extend to five hundred rupees, or with both.

Penalty for counterfeiting or defacing marks on trees and timber and for altering boundary-marks.
(I. F. A. 63.)

39. Whoever, with intent to cause damage or injury to the public or to any person, or to cause wrongful gain as defined in the Indian Penal Code—

(*a*) knowingly counterfeits upon any timber or standing tree a mark used by Forest-officers to indicate that such timber or tree is the property of the Government or of some person, or that it may lawfully be cut or removed by some person; or

(*b*) alters, defaces or obliterates any such mark placed on a tree or on timber by or under the authority of a Forest-officer; or

(*c*) alters, moves, destroys or defaces any boundary-mark of any forest or waste-land to which the provisions of this Act are applied;

shall be punishable with imprisonment for a term which may extend to two years, or with fine, or with both.

Power to arrest without warrant. (I. F. A. 64.)

40. (*1*) Any Forest-officer or Police-officer may, without orders from a Magistrate and without a warrant, arrest any person against whom a reasonable suspicion exists of his having been concerned in any forest-offence punishable with imprisonment for one month or upwards.

(*2*) Every officer making an arrest under this section shall, without unnecessary delay and subject to the provisions of this Act as to release on bond, take or send the person arrested to the Magistrate having jurisdiction in the case or to the officer in charge of the nearest police-station.

Power to release on a bond a person arrested. (I. F. A. 65.)

41. Any Forest-officer of a rank not inferior to that of a Ranger, who, or whose subordinate, has arrested any person under the provisions of Section 40, may release such person on his executing a bond to appear, if and when so required, before the Magistrate having jurisdiction in the case or before the officer in charge of the nearest police-station.

Power to prevent commission of offence. (I. F. A. 66.)

42. Every Forest-officer and Police-officer shall prevent, and may interfere for the purpose of preventing, the commission of any forest-offence.

Power to try offences summarily. (I. F. A. 67.)

V of 1898.

43. The District Magistrate or any Magistrate of the first class specially empowered in this behalf by the Government may try summarily, under the Code of Criminal Procedure, 1898, any forest-offence punishable with imprisonment for a term not exceeding six months, or fine not exceeding five hundred rupees, or both.

Power to compound offences. (I. F. A. 68.)

44. (*1*) The Government may, by notification, empower a Forest-officer—

(*a*) to accept from any person against whom a reasonable suspicion exists that he has committed any forest-offence, other than an offence specified in Section 38, or Section 39, a sum of money, not exceeding fifty rupees, by way of compensation for the offence which such person is suspected to have committed; and

(*b*) when property of such person has been seized as liable to confiscation, to release the same.

(*2*) On the payment of such sum of money, to such officer, the suspected person, if in custody, shall be discharged, the property, if any, seized shall be released, and no further proceedings shall be taken against such person or property.

(3) A Forest-officer shall not be empowered under this section unless he is a Forest-officer of a rank not inferior to that of a Ranger and is in receipt of a monthly salary amounting to at least one hundred rupees.

Onus of proof.

45. (1) Notwithstanding anything contained in any other Act, when in any area in respect of which Government has made rules under clause (*b*) of sub-section (2) of Section 41 of the Indian Forest Act, 1927, any person is found to be moving forest-produce without a pass from an officer duly authorised to issue the same, the burden of proof that such person has not committed an offence under this Act in respect of such forest-produce shall lie on him.

(2) Any person appointed by the Regional Forest-officer in this behalf shall be deemed to be an officer authorised to issue passes under the clause aforesaid

CHAPTER V.

Of Regional Forest-officers and other Public Servants.

Government may invest Regional Forest-officers with certain powers.
(I. F. A. 72.)

46. (1) The Government may invest any Regional Forest-officer with all or any of the following powers, that is to say:—

(*a*) power to enter upon any land, or to cause his officers with their servants and workmen to enter thereon, and to survey, demarcate and make a map of the same;

(*b*) the powers of a Civil Court to compel the attendance of witnesses and the production of documents and material objects;

(*c*) power to issue a search-warrant under the Code of Criminal Procedure, 1898; and V of 1898.

(*d*) power to hold an inquiry into forest-offences, and, in the course of such inquiry, to receive and record evidence.

(2) Any evidence recorded under clause (*d*) of sub-section (1) shall be admissible in any subsequent trial before a Magistrate, provided that it has been taken in the presence of the accused person.

Powers of officers.

47. It shall be lawful for any officer authorised in this behalf either generally or specially by the Regional Forest-officer and for his subordinates with their servants and workmen at any time to enter upon any

part of a controlled forest for the purpose of ascertaining whether there has been any violation of an approved working plan and to do any other acts necessary in his opinion for carrying out that purpose.

48. All Forest-officers shall be deemed to be public servants within the meaning of the Indian Penal Code. XV of 60.

Forest-officers deemed public servants.

(I. F. A. 73.)

49. No suit shall lie against any public servant for anything done by him in good faith under this Act.

Indemnity for acts done in good faith.

(I. F. A. 74.)

CHAPTER VI.

MISCELLANEOUS.

50. The Government may make rules to regulate the following matters in respect of forests in a notified area, namely:—

Power to make rules.

(I. F. A. 32.)

(*a*) the cutting, sawing, conversion and removal of trees and timber, and the collection, manufacture and removal of forest-produce;

(*b*) the granting of licences to the inhabitants of towns and villages in the vicinity of vested forests to take trees, timber or other forest-produce for their own use, and the production and return of such licences by such persons;

(*c*) the granting of licences to persons for felling or removing trees or timber or other forest-produce from vested forests for the purposes of trade, and the production and return of such licences by such persons;

(*d*) the payment, if any, to be made by the persons mentioned in clauses (*b*) and (*c*) for permission to cut such trees, or to collect and remove such timber or other forest-produce;

(*e*) the other payments, if any, to be made by them in respect of such trees, timber and produce, and the places where such payment shall be made;

(*f*) the examination of forest-produce passing out of forests;

(*g*) the clearing and breaking up of land for cultivation or other purposes in forests;

(*h*) the protection from fire of timber lying in forests;

(*i*) the cutting of grass and pasturing of cattle in forests;

(*j*) hunting, shooting, fishing, poisoning water and setting traps or snares in vested forests, and the killing or catching of elephants in such forests in areas in which the Elephants' Preservation Act, 1879, is not in force; VI of 1879.

(*k*) to prescribe and limit the powers and duties of any Forest-officer under this Act;

(*l*) to regulate rewards to be paid to officers and informers out of the proceeds of fines and confiscation under this Act;

(*m*) to compel the owner of a controlled forest to submit to the Regional Forest-officer annual returns showing how far he has adhered to or deviated from the prescriptions of a working plan;

(*n*) generally, to carry out the provisions of this Act;

(*o*) the granting of loans to the owners of controlled or vested forests;

(*p*) the manner of making applications for such loans; and

(*q*) the conditions on which such loans may be granted.

Rules when to have force of law.
(I.F. A. 78.)

51. All rules made by the Government under this Act shall be published in the *Calcutta Gazette*, and shall thereupon, so far as they are consistent with this Act, have effect as if enacted therein.

Recovery of money due to Regional Forest-officer and lien on forest-produce for such money.
(I. F. A. 82 & 83.)

52. (*1*) All money payable to a Regional Forest-officer under this Act or under any rule made under this Act, other than money payable in respect of the cost of management of a vested forest, and all money payable to such officer on account of the price of any forest-produce or on account of expenses incurred in the execution of this Act in respect of such produce shall, if not paid when due, be recoverable as a public demand.

(*2*) When any such money is payable for or in respect of any forest-produce, the amount thereof shall be deemed to be a first charge on such produce, and such produce may be taken possession of by a Regional Forest-officer until such amount has been paid.

(*3*) If such amount is not paid when due, the Regional Forest-officer may sell such produce in the prescribed manner, and after payment of the costs of the sale the proceeds thereof shall be applied first in discharging the amount.

(*4*) The surplus, if any, if not claimed within two months from the date of the sale by the person entitled thereto, shall be forfeited to the Government.

53. Nothing done under this Act shall be invalid merely because an order which should have been served upon, a notice which should have been issued to, or a copy which should have been supplied to, an owner of any forest or of any land, or a person entitled to cultivate any land or a person interested in any land has in good faith been served upon or issued or supplied to any person who is believed to be but is not in fact such owner or a person so entitled or interested unless substantial injury is caused thereby.

Nothing to invalidate acts merely because of mistaken identity of the owner or interested person.

54. Whenever it appears to the Government that any land is required for any of the purposes of this Act, such land shall be deemed to be needed for a public purpose within the meaning of Section 4 of the Land Acquisition Act, 1894.

Land required under this Act to be deemed to be needed for a public purpose under the Land Acquisition Act, 1894.

(I. F. A. 84.)

55. If persons having in the aggregate more than a half interest in any forest, or in any such land as is described in sub-section (*1*) of Section 9, have applied in writing to the Collector of the district in which such forest or land is situated, the Government may, by notification, notwithstanding the provisions of Section 1 and subject to such restrictions or conditions as may have been determined by an agreement with such persons, apply the provisions of this Act to such forest or land as if it were a vested forest.

Conservation of forest, or afforestation of land, at request of owners.

(I. F. A. 38.)

NOTE OF DISSENT BY MR. RAI HARENDRA NATH CHAUDHURI.

I regret owing to my unfortunate illness at the time I could not participate in the tour programme of the committee. However, I accept what my colleagues have to say regarding their experiences and attach full importance to the illustrations that they have given of vanishing forests and denuded soils together with the instances of erosion witnessed by them.

But important though the instances of depletion and denudation are for us to appreciate the nature of the problems connected with the area to which our enquiry is directed, it is doubtful whether they are matters for greater surprise than the continued existence of these private forests in areas under the Permanent Settlement where the ordinary revenue and rent laws operate and which lie on the borders of a predominantly agricultural country with steadily increasing pressure of population. The Permanent Settlement of 1793, it is well known, was a standing invitation to forest clearance and extension of agriculture. No idea of forest preservation or silvicultural pursuits, nor of what are called "protection forests" in the West entered into the settlement of the woodlands located in these permanently settled districts. If promotion of agricultural operations and fixation of state demands were among the objects of the epoch-making measure, punctual payment of land revenue it was also designed to secure; and such payment continued to be enforced rigorously by the Revenue Sale Law (Act XI of 1859) and its forerunners. Again, if the annual revenue of the zemindars has generally to be paid in quarterly *kists* the *putnidars* have to pay up their dues, unless earlier as per stipulation, under a summary process at the end of every six months. Similarly the rent law or the Bengal Tenancy Act provides for payment of rents by tenure-holders in four *kists*. On the top of all, the general law of inheritance obtaining in this country, contrary to the law of entailed inheritance prevalent in England, finds its application in every generation to promote division and split up interests. The result is that the forests in the area under consideration had and have to bear the recurring revenue and rent burdens wholly inconsistent with the delayed yield and deferred return of silvicultural operations while suffering the neglect of divided interests at times. In the circumstances is it something unexpected that the *putnidar's* or small owner's forests will bear marks of progressive deterioration or the co-owner's forests of improvident exploitation when even the large entailed forests of England present in many cases "a sad picture of neglect"? On the contrary it may appear not a little amazing that these forests did not disappear so long and even belied the gloomy forecasts of experts like Messrs. Shebbeare and Homfray (*vide* paragraphs 34 and 35 of the Report). Nearly fifteen years have passed from the date of the former's forecast yet the Bankura forests—the worst of the lot—have not come to "see the end" of their days as predicted, while twelve years after the latter's prophecy that in "20 years there will be hardly an acre of forest left in the Bankura district," the forests there have not surely half disappeared despite all the signs of "devastation." It cannot be excessive optimism, therefore, to hold that, the danger of rapid destruction notwithstanding, the the stage of complete destruction is not likely to be reached very soon,

particularly when in 1937 quite an increased area of 1,236·30 square miles of forest could be estimated (disputed though that estimate may be) as against the cadastral survey record of 1,061 square miles of the earlier decades.

In offering these preliminary remarks I should make it clear that it is not my purpose to deny the danger to private forests somewhat inherent in the situation, nor to ignore the facts of depletion or denudation that demand measures for improvement and reafforestation. I have only attempted to indicate, on the one hand, the back-ground against which these forests stand and such causes making for "devastation" as have not been sufficiently dealt with or stressed in the Report, and, on the other, to suggest that however much measures for regeneration and reconstruction appear to be necessary no unduly restrictive or virtually exproprietary measures are immediately called for to meet the present situation in respect of the "production forests", though schemes for reclamation of denuded areas or soils may be undertaken as early as practicable on the lines indicated below.

What then are the measures that should be adopted to solve the problems of conservation and reconstruction that present for solution in the areas under enquiry? The measures that have been adopted with such ends in view in other countries in respect of private forests generally fall into three classes:—

(1) acquisition and working by the State.

(2) State control through legislation and

(3) State assistance, co-operation and voluntary organisation.

(1)

In most European countries, the State forests cover a much smaller percentage of the total areas under forest than private forests. There, as Dr. Troup says:—

> "the general tendency now is towards an increase in the proportion in State ownership. This is due partly to the increasing importance attached to the maintenance of protection forests under immediate State management, partly to a feeling that State ownership means greater security in the matter of timber supplies and national defence, and in certain cases to the introduction of forms of government which put nationalization in the forefront of general policy."

When such is the tendency in Europe, in America acquisition of private forests has come to be regarded as the only practicable method of ensuring the future maintenance of forests. If "the Weeks Act of 1911 provided for the purchase of private forest land by the Forest Service primarily for the protection of water-catchment areas," "the Clarke-McNary Act (of 1924) extended their power to the purchase of forest lands for timber production" and very large acquisitions have been made after vast expenditure of public money.

It will be admitted of course that what is possible for the United States of America is not possible for a poor Provincial Government

like the Government of Bengal. But if the Bengal Government can really depend on its forest service why can it not undertake a much humbler scheme of acquisition of denuded lands in particular for reafforestation as contemplated in section 37 of the Indian Forest Act? Successful demonstration may induce private persons to come to voluntary agreements where coercion and compulsion are thought of at present. Surely lands that are subject to recurring revenue and rent demands and yielding returns however small that can induce their owners not to part with them at public auctions, cannot, merely by creating legal sanctions, be justly and equitably taken over permanently or for indefinitely long term without compensation or solatium as the proposed Bill appears to suggest.

(2)

To come to a consideration of State control through legislation designed for the preservation and improvement of private forests it has to be remembered that in the West as distinguished from India, the State, in a large majority of cases, is the owner of a small fraction of the forest lands. None of the European States, except Russia, Estonia, Latvia, Greece and Yugoslovia, owns more than 40 per cent. of the total area under forests. Even States like Finland and Sweden where forest provides for a staple industry have less than 40 per cent. of forests under State ownership, while Norway and Czecho-slovakia have only 15·0 or 11·3 per cent. of their woodlands as State forests. In the circumstances it is only natural that such States, particularly those that depend for their staple industries on forests or own only a small fraction of their timber resources, will attempt to exercise strict control over the operations of private forests. Of these States the now defunct State of Czecho-slovakia had a "very strict" control over her private forests to enforce proper management.

> "A new and stricter law was passed in 1928 and brought into force by Decree No. 97 of 1930. Under this law, subject to exceptions in certain cases, all private forests exceeding 50 hectares (124 acres) in area,"....."require to be managed under a working plan drawn up by a qualified officer and approved by authority. The manner in which working plans are to be prepared is laid down in some detail in the decree. Deviations from the prescriptions of working plans require the approval of the sanctioning authority. In cases where working plans are not compulsory, restrictions are laid down as to the maximum area to be felled annually. Save in exceptional cases, a minimum rotation has to be observed."
>
> "The reafforestation of cleared areas is compulsory. If the owner fails to carry out the work satisfactorily and punctually, the Government may carry it out at his expense, deducting the cost from his security."
>
> "Apart from penalties (fine or imprisonment) for breach of the law, in case of a serious breach or fear that such breach will be repeated the Minister of Agriculture may cause an estate to be placed under administration at the owner's expense; this does not apply to large estates under distraint."

"Only about 3·8 per cent. of the total forest of Czecho-slovakia is classed as protection forest." "All protection forests above a minimum area (700 ha. in Bohemia, 575 ha. in Moravia, 500 ha. in Silesia, no minimum in Slovakia and Carpathian Ruthenia) have to be managed by a qualified Forest Manager employed by the owner, or if the area is too small to justify this, by a State forest officer subject to the payment of a fee for management costs. It is laid down that protection forests are to be managed under the selective system, and there are severe penalties for evading this rule. In the case of protection forests, as of other forests, a working plan is required for every forest exceeding 50 ha. in area."

"Under the new Czecho-slovak democratic system, however, the tendency is to abandon discrimination between protection and other forests, and to require proper management for forests of all categories." (Forestry and State control by R. S. Troup: Professor of Forestry in the University of Oxford, pages 46-48.)

I give this long quotation just to show how the Bill appended to our Report closely resembles one of the harshest, if not the harshest, of the legislative measures adopted by the European States to deal with their private forests. Even the distinction between "production" and "protection" forests that with all the tendency to obliterate it has still been recognised in the Czech law and fully recognised in other countries is missed in the recommended Bill. The Bill, though it may not create much concern among the large and resourceful owners, is likely to create a consternation among the small owners, *putnidars* and tenure-holders who may find their forest areas improved but themselves landed in great difficulties and practically divested of their properties without getting suitable compensation for the same or even relief from their existing burden. To be generally acceptable it will have to be largely recast and purged of its harsh coercive character, making a clear distinction between "production" and "protection" forests, providing for their separate treatment and for liberal schemes of State assistance, aid and relief.

Dr. Troup who favours State control through legislation (though the same could not be recommended for Great Britain by the conference on private forestry convened by the Forestry Commission in London even in February 1938 notwithstanding the sad condition of a majority of her private forests and the vital importance of home-grown timber for her scheme of national defence) however points out:—

"Experience in countries where control over private forestry is exercised has shown that too strict a measure of compulsion destroys personal interest and leads to evasion of regulations, while too rigid a control over forest technique may result in killing initiative and sense of responsibility. So long as public interests are safeguarded, and a policy which ensures this is followed, the ideal is to promote community of interest between the private owner and the State, to encourage initiative, and to apply compulsion only where other methods fail."

(3)

Apart from acquisition and State management noticed before, what are the other measures then that can and should be adopted here for the preservation and improvement of private forests and reclamation of denuded areas? Obviously it is necessary to make a clear distinction between "production" and "protection" purposes; in other words, between areas where forests exist but require conservation and development through better management and areas where forests have been destroyed and the soil denuded resulting in erosion, superficial or deep, which demand reafforestation and reconstruction on a large scale. As regards the former the following measures appear to be necessary and to have been adopted or recommended for adoption by one country or another:—

(1) propaganda to educate the forest owners on the importance of the proper management of forests as recommended by the conference on private forestry held in London in February 1938;

(2) encouragement and assistance to forest owners to act on constructive lines and particularly to small owners to act on co-operative principles;

(3) provision for free technical assistance and advisory service;

(4) organisation of district and divisional forest councils with a provincial forestry board on the top;

(5) prevention of further wasteful clearances by prohibiting large clearances without previous notice to the Government; and prohibition also of harmful practices; and

(6) provision for financial assistance where forest owners agree to work according to official plans and under official supervision.

In respect of forests of the latter class, viz., "protection" forests where reafforestation of denuded areas is necessary to prevent erosion or control floods, and protracted work on a comparatively large scale yet not of immediately remunerative types has to be carried out:—

(1) Government should start demonstration of the possibilities of reafforestation work.

(2) Government may acquire such lands and work out reafforestation plans on the lines suggested by Mr. Nath in his report.

(3) Liberal financial assistance should be given to owners in "protection" areas who undertake work of reafforestation on their own responsibility but on plans approved by experts and carried out under the supervision of the Forest Department. How liberally some of the European countries assist private "protection forests" can be appreciated from the instances furnished by France and Italy. "Plantations on summits and slopes of mountains, or on sand-dunes are exempt" in France "from all taxation for thirty years, and plantations on burnt areas are exempt for a period equal to the age of the wood destroyed by fire, subject to a maximum of twenty years (*cf.* Article 226, law of July 19, 1932)." While in Italy "Assistance by the state to private persons for afforestation in the mountains includes

a subsidy up to two-thirds of the cost of the work and exemption from taxation for a period of fifteen to forty years." Even in a small country like Switzerland "Contributions towards the cost of protective work on private estates (for instance, afforestation, reinforcement of roads, draining, construction of retaining walls of barriers against avalanches, rock-slides, etc.) are made by the Federal Council and the canton, according to prescribed shares for different kinds of work."

It is like putting the cart before the horse to say that "One of the surest ways, in which legislation passed in the interests of the public generally can be made less unpopular is to foster the growth of associations of private forest-owners giving them facilities for obtaining expert advice and help, and even monetary assistance, so that forest education among the people in general may gradually be built up and eventually it may be unnecessary to enforce the law in its full rigour, as the public come to realise that forest policy is designed for their benefit." For, enactment of a strict law before trying other measures of encouragement defeats its own purpose, and it is worth repeating Dr. Troup's observation "destroys personal interest and leads to evasion of regulations, while too rigid a control over forest technique may result in killing initiative and sense of responsibility." Compulsion can be applied "only where" and when "other methods fail." Rigorous provisions are enacted when the necessity arises for their enforcement and not with the idea that their enforcement may in future be unnecessary.

1. 'Sal coppice with standards, before deterioration has set in as a result of unregulated fellings.'

(Bankura-Mejhia road.)

2. 'Dense Sal coppice of good quality, 5-6 years old, with the clear-felled coupe of the current year in the foreground.'

(Gangajalghati, Bankura.)

3. 'Sal coppice, 4-5 years old, of poor quality showing the invasion of miscellaneous species, and the thinning out of Sal.'

(Bankura-Mejhia road.)

4. 'Erosion on the edge of Sal forest. Sheet erosion in an advanced stage.'

(Suri-Dubrajpur road.)

5. 'Sal forest almost destroyed. Erosion very heavy owing to the slope of the land.'

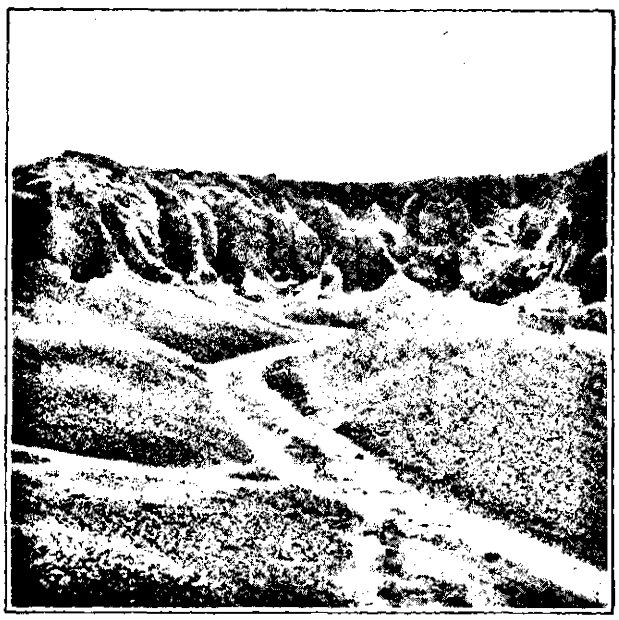
(Bankura-Mejhia road.)

6. 'Danga land from which the surface soil has been completely eroded and the laterite rock exposed. The only vegetation is thorny scrub—Zizyphus species. Slope nil: compare No. 5.'

(Bankura-Gangajalghati road.)

7. 'A FURTHER STAGE IN EROSION, SHOWING THE EXPOSURE OF THE ROCK ON COMMENCEMENT OF GULLYING.'

(BANKURA-MEJHIA ROAD.)



8. 'THE FINAL STAGE SHOWING THE FORMATION OF RAVINE LAND AND A TYPICAL STREAM IN WESTERN BENGAL, WHICH IS ALMOST DRY IN THE COLD WEATHER BUT LIABLE TO SUDDEN FLOOD AFTER RAIN.'

(MALANDIGHI, BANKURA.

APPENDIX I.

RESOLUTION—No. 14670For.

Calcutta, the 25th July 1938.

It has been brought to the notice of Government that owing to the progressive denudation of forests in West Bengal by tenants and private owners the supply of timber and firewood has become endangered and that there is reason to believe that owing to soil erosion, large tracts of lands are becoming bare and almost unproductive. There is also reason to apprehend that the destruction of the forests is rendering West Bengal as a whole more and more liable to flood and drought.

If this estimate of the situation is correct, it is clearly a matter of public importance that measures should be taken to preserve what is left of these forests. Government have therefore decided to appoint a Committee to investigate the facts and to make recommendations to Government as to the remedies which should be applied to prevent this grave threat to the prosperity of the countryside.

2. The terms of reference will be as follows:—

(*i*) Is it advisable to take measures in West Bengal for—

(*a*) the conservation of those forests which still exist there;

(*b*) the re-afforestation of any areas which have been denuded of forests; and

(*c*) the afforestation of any areas which have been rendered unproductive in consequence of deforestation?

(*ii*) If so, what measures, having regard to the reasonable needs of the local people, should be adopted and by what agency should they be carried out?

(*iii*) What changes would, in consequence, be advisable in the existing law?

3 The area of the enquiry comprises the districts of Bankura, Birbhum, Burdwan and Midnapore.

4. The Committee will consist of—

Chairman (*ex-officio*).

(1) The Commissioner, Burdwan Division.

Members.

(2) Maharaja Sashi Kanta Acharjya Choudhury of Muktagachha.
(3) Mr. J. N. Basu, M.L.A., Solicitor.
(4) Maharaj Kumar Udaya Chand Mahtab, M.L.A., Burdwan.
(5) Khan Bahadur Maulvi Naziruddin Ahmad, M.L.C.
(6) Mr. Rai Harendra Nath Chaudhury, M.L.A.

(7) Mr. Banku Behary Mondal, M.L.A.

(8) Maulvi Abdul Bari, M.L.A.

(9) Mr. Birat Chandra Mandal, M.L.A.

(10) Mr. Syed Mostagawsal Haque, M.L.A.

(11) Mr. G. W. Woodgates.

(12) Mr. C. E. Simmons, I.F.S., Conservator of Forests, Southern Circle, Bengal.

(13) The Collector of Midnapore (*ex-officio*).

(14)) Mr. Y. S. Ahmad, I.F.S., Divisional Forest Officer, Dacca-Mymensingh.

Mr. Y. S. Ahmad will also act as Secretary of the Committee.

5. ORDERED that this resolution be published in the "Calcutta Gazette" and copies thereof be forwarded to the members of the Committee for information.

ORDERED ALSO that copies of the resolution be forwarded to the Commissioner of the Burdwan Division, the Senior Conservator of Forests, Bengal, and all departments of Government for information.

By order of the Governor,

N. V. H. SYMONS,
Secretary to the Government of Bengal.

APPENDIX II.

Questionnaire.

It has been brought to the notice of Government that owing to the progressive denudation of forests in West Bengal by tenants and private owners the supply of timber and firewood has become endangered and that there is reason to believe that owing to soil erosion, large tracts of lands are becoming bare and almost unproductive. There is also reason to apprehend that the destruction of the forests is rendering West Bengal as a whole more and more liable to flood and drought.

The Government of Bengal in their Resolution No. 14670For., dated the 25th July 1938, have appointed a Committee to enquire if this estimate of the situation is correct, to investigate the facts, and to make recommendations to Government as to the remedies which should be applied to prevent this grave threat to the prosperity of the country side.

The Committee accordingly prepared the following questionnaire :—

General.

1. What is the area covered by forests in your Zamindari?

2. What are the principal species of trees in your forests? What is the percentage of (*a*) Sal, (*b*) Kendu, Asan (or Asna), Peasal, Mohwa, Simal, Kusum and (*c*) other species?

3. How much of the forest is—

(*a*) in your khas possession?

(*b*) in the possession of tenure-holders?

4. How much under head (*a*) and head (*b*) of question 3 respectively has been leased out for the purpose of the commercial extraction of timber and firewood? (If possible gives areas leased in each in the last ten years.)

5. (1) Have you noticed any deterioration in your forests, and, if so, what form has it taken and from what date did it start?

(2) What, in your opinion, were the causes of deterioration of your forests?

6. Is such deterioration greater—

(*a*) in the forests still held in khas possession by—

(*i*) yourself, or

(*ii*) your tenure-holders, or

(*b*) in the forests leased out to contractors?

7. (*a*) What area, if any, in your Zamindari, that was previously covered by forests, is now altogether devoid of vegetation?

(*b*) If so, what has in your opinion caused this?

(*c*) Has any part of such area been temporarily under cultivation, and, if so, for how long has it been under cultivation?

(*d*) Has any land near your forests (but not itself forest within recent times) gone out of cultivation?

8. (*a*) Has the supply of timber and firewood from your forests shown any decrease in quantity during the last ten years?

(*b*) Have you had any complaints from your tenants over the quantity or quality of (*i*) poles, (*ii*) small timber, (*iii*) firewood, (*iv*) Sal leaves, (*v*) thatch grass, and (*vi*) grazing, in your forests?

9. (*a*) Have you noticed any deterioration in any rivers or streams in or near the forests?

(*b*) In particular, has the flow of water been affected and, if so, how and to what extent?

(*c*) Have you noticed any silting of rivers or streams which you consider to be due to denudation?

Exercise of rights by villagers.

It is sometimes found that the villagers abuse their rights in the forests and as a result considerable damage is done. Reckless and wasteful cutting by villagers does perhaps more harm to the forests than working by contractors.

10. What are the rights exercised or claimed by villagers in different forest areas of your Zamindari?

11. How far are these rights covered by entries in the settlement records?

12. Are these rights exceeded or abused by the villagers? If so, how and to what extent? Has there been any tendency to utilise these rights to a greater extent than used to be the case?

13. In particular, is there any wasteful or reckless cutting? ("Wasteful cutting" means, for example, cutting a tree larger than is required. "Reckless cutting" means cutting in such a way as to damage other trees.)

14. What steps, if any, do you take to prevent wasteful or reckless cutting or abuse of rights by villagers? Does it pay you to take such steps?

15. Is there any wastage of young Sal saplings for fencing fields? What steps are taken, if any, to prevent this?

16. (*a*) Is there much damage done in the forests of your Zamindari by grazing?

(*b*) What is the nature and extent of grazing rights exercised by villagers in the different forests of your Zamindari?

(*c*) Do you consider that the grazing rights as exercised by the villagers are in themselves prejudicial to the interests of forests in your Zamindari, e.g., hardening the soil or destroying young Sal shoots? If so, please give details.

17. (*a*) Is there much destruction or deterioration of forests in your Zamindari owing to fire?

(*b*) To what extent, if at all, are such fires deliberately started, and for what reasons?

(*c*) What steps, if any, do you take to prevent such fires?

Exploitation of forests.

It has been alleged that one of the main causes of denudation of forests in West Bengal is over-exploitation by contractors who are interested only in the amount of profit they can make. Some Zamindars have also been said to disregard their ultimate interests in return for immediate gain. Even now the majority of forests in West Bengal are reported to be coppiced under very short rotations, the interval between successive cuttings in many cases being as short as three years. It is not realised that the vitality of the root-stock from which coppice shoots arise depends on the vigour of the shoots and if these are cut too frequently the root-stock must die. It is further stated that another and perhaps the most potent factor in the destruction of forests has been the extension of cultivation. With the growth of population and consequent pressure on land, extension of cultivation at the cost of forest has been proceeding at a rapid pace. Extension of cultivation is no doubt beneficial to the community but a point is reached when extension can proceed only at a considerable loss to the local people as well as to the people of the province as a whole.

18. To what extent do you lease out forest land to be cleared for purposes of cultivation? To what extent are the stumps of Sal trees dug out completely when this is done?

19. When you do this, what salami is usually paid, what is the rate of rent, and what proportion of land so leased remains permanently under cultivation?

20. Do you have a definite programme for preserving your forests as a permanent asset? If so, what is it? What permanent staff do you maintain for this purpose?

21. What is the "rotation", i.e., the interval generally allowed between successive cuttings—

(*a*) in your khas forests,

(*b*) in your tenure-holders' forests, and

(*c*) by contractors?

22. In each of the last ten years or as many years for which figures are available, what was the total area worked under a rotation of 3, 4, 5, 6, 7, 8, 9, 10, or more years respectively?

23. When you lease out forest for commercial extraction of timber or firewood—

(*a*) Is there a formal lease and, if so, what are its main conditions?

(If you have a standard form please supply a copy.)

(*b*) In particular do you impose any conditions to prevent waste and ensure early regeneration?

(*c*) Do you ever lease out the right to dig up or grub out Sal roots for making charcoal or for any other purpose? Do you allow this practice even though it is not definitely mentioned in the lease?

(*d*) What steps are taken to see that the conditions of the lease are adhered to?

(*e*) What is the staff maintained by you for—

(*i*) Supervising the work of contractors?

(*ii*) Protecting new coppice shoots against the villagers and cattle?

(*f*) Has this staff any forest training?

24. What is your income, gross and nett, from your forests for (*a*) timber, (*b*) firewood, and (*c*) other forest produce for each of the last ten years, or for as many years for which figures are available?

If you cannot give these figures, can you give a figure for average income per acre exploited and say whether it is tending to increase or decrease?

25. What quantities, roughly speaking, of (*a*) timber, and (*b*) firewood, from your forests have been sold—

(*i*) by yourself,

(*ii*) by your tenure-holders, and

(*iii*) by contractors in each of the past ten years, or of as many years for which figures are available?

26. What is the average price of (*a*) timber, and (*b*) firewood in each year for which you give quantities?

27. If possible, give quantities and prices for different areas worked under different rotations (e.g., 3, 5, 7, or 10 year rotations).

28. Can you give an idea of the amount of labour employed in these forests in a year and the value of their wages?

Remedies.

It is necessary to know the views of the land owners about the various measures which have been suggested from time to time or which are already provided in the Forest Act for the conservation of forests which still exist.

Under section 35 of the Indian Forest Act XVI of 1927—

(1) The Local Government may, by notification in the local official Gazette, regulate or prohibit in any forest or wasteland—

(*a*) the breaking up or clearing of land for cultivation;

(*b*) the pasturing of cattle; or

(*c*) the firing or clearing of the vegetation;

when such regulation or prohibition appears necessary for any of the following purposes:—

(*i*) for protection against storms, winds, rolling stones, floods and avalanches;

(*ii*) for the preservation of the soil on the ridges and slopes and in the valleys of hilly tracts, the prevention of landslips or of the formation of ravines and torrents, or the protection of land against erosion, or the deposit thereon of sand, stones or gravel;

(*iii*) for the maintenance of water-supply in springs, rivers and tanks;

(*iv*) for the protection of roads, bridges, railways and other lines of communication;

(*v*) for the preservation of the public health.

(2) The Local Government may, for any such purpose, construct at its own expense, in or upon any forest or waste-land, such work as it thinks fit.

(3) No notification shall be made under sub-section (*1*) nor shall any work be begun under sub-section (*2*), until after the issue of a notice to the owner of such forest or land calling on him to show cause, within a reasonable period to be specified in such notice, why such notification should not be made or work constructed, as the case may be, and until his objections, if any, and any evidence he may produce in support of the same, have been heard by an officer duly appointed in that behalf and have been considered by the Local Government.

Under section 36, the Local Government may place such forest or land under the control of a Forest Officer.

Under section 37, the owner of the forest may, at any time not less than three or more than twelve years, require that such forest or land shall be acquired for public purposes, and the Local Government shall acquire such forest or land under the Land Acquisition Act. These provisions have not been considered at all in Bengal as Government were not in a position to acquire such forests or land at public expense.

Under Section 38, the owner of a forest may approach Government to have his forest managed by a Forest Officer. This provision has not

also worked so far in Bengal except in Dacca and Mymensingh districts and the owners do not generally realise the importance of conserving the forests both from the point of view of their own interests and that of the community as a whole.

The entire position was examined by the Stephenson Committee in 1909 who drafted a Bill, the objects of which were stated to be—

(*i*) to empower the Government to intervene, in the public interest, to preserve private forests from destruction; and

(*ii*) to facilitate, or, in some cases direct, the afforestation of private waste lands.

The chief purpose of the Bill was to allow Government to intervene without any liability to acquire the forest at public expense at any stage which has been the main stumbling block to such intervention, under Section 36 of the Indian Forest Act.

29. Are you in favour of fresh legislation such as proposed by the Stephenson Committee? If not, why not?

30. In your opinion will it be sufficient to amend Section 37 of the Indian Forest Act, so that Government may take over control of a private forest without having to acquire it compulsorily at any stage?

31. Do you prefer a system in which the forests of private owners may be managed by Government by voluntary agreement or lease?

32. Have you any other proposals to make to meet the situation?

APPENDIX III.

Total tonnage of firewood despatched by the Bengal-Nagpur Railway from stations in Midnapore and Bankura districts.

Station from.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.	1936.	1937.		1938.	Average.
	Firewood. Tons.	Firewood. Tons.	Firewood. Tons.	Firewood. Tons.	Firewood. Tons.	Firewood. Tons.	Timber. Tons.	Firewood. Tons.	Timber. Tons.	Firewood. Tons.
Midnapore district—										
Gidni	6,028	8,083	9,082	8,663	8,349	6,527	272	5,843	800	7,366
Jhargram	7,794	11,208	15,405	24,715	20,367	21,381	40	22,908	77	17,825
Surdiah	5,740	3,893	8,973	12,922	9,396	5,265	30	4,286	143	7,211
Kharagpur	15	399	29	276	143	..	7	..	24	123
Dantan	657	585	768	35	11	13*	21*	384*	60*	353
Godapeasal	9,783	13,348	12,206	8,845	12,025	12,705	315	17,839	642	12,393
Salboni ..	7,146	9,668	12,841	10,578	9,711	8,191	75	10,131	17	9,752
Chandrakona Road ..	20,515	20,635	21,710	17,189	20,462	17,825	1,918	20,314	2,479	19,807
Garbetta	17,491	12,148	9,146	12,988	16,260	16,848	2	13,424	276	14,043
Total ..	75,169	79,967	90,160	96,211	96,724	88,758	2,680	95,129	4,517	88,874
Bankura district—										
Peardoba	12,447	9,103	11,888	8,500	9,813	15,855	136	12,053	207	11,384
Vishnupur	578	1,344	1,855	1,113	318	655	112	580	69	920
Ondagram	1,255	..	612	..	253	2,813	251	2,149	645	1,012
Bheduasole	..	..	1,477	..	184	..	55†	..	412†	237
Total ..	14,280	10,447	15,862	9,613	10,568	19,323	554	14,782	1,333	13,553
Grand Total	89,449	90,414	106,022	105,824	107,292	108,081	3,234	109,911	5,850	102,428

*Includes Contai Road.
†Includes Bankura.

APPENDIX IV.

Extract from Mr. J. C. Nath's Report of 1937.

Situation and Physical Features.—The *sal*-bearing tract of Western Bengal is a large expanse of undulating and rugged country that lies within the districts of Midnapore, Bankura, Burdwan and Birbhum, along the western borders of Bengal. It extends over a length of country about 140 miles from Birbhum district in the north to Midnapore district in the south; its greatest width is about 60 miles and the smallest about 8 miles from east to west, in Midnapore and Birbhum districts respectively * * *. This forms the connecting link between the alluvial plains of Bengal, the land of silt and swamp, on the east and the Chota Nagpur plateau and the Santal Parganas on the west. Throughout almost this entire tract the surface is broken up by a succession of undulations. Near the western boundary these undulations become more and more marked rising into high ridges of laterite, and rocky hillocks in places. In the south-west of Bankura district and extreme north-west of Midnapore district there appears a tangle of hills rising to a height of 1,000 feet or so arranged in no particular plan, with steep sides and narrow intervening valleys. There are also two isolated hills, Sushunia Hill and Biharinath Parbat, in Bankura district, which rise to about 1,500 feet or so. Where this tangle of hills and ridges joins on to the rest of the tract the hills stop abruptly and give place to the long gentle undulations which are characteristic of the entire tract. Most of these hills and high ridges and the summits of the lower undulations are covered with dense low growing jungle interspersed with open park-like stretches of uncultivated land dotted with fine isolated trees; and in places too there are expanses of absolutely barren land, treeless and sparsely clothed with coarse grasses, only the bottoms of the valleys being cultivated. As these undulations become less and less steep, rice is grown in terraces up the sides, and only the broad, flat and usually dry summits are left untilled, forming in the rains scanty pasture grounds. The minor undulations are terraced up to the top. In the east these undulations become less pronounced and gradually merge into the broad alluvial plains of Bengal.

The River System.—The rivers and streams flow in deep channels cut in the rocky soil, the smaller ones practically dry in the hot weather when even some of the larger rivers are reduced to mere trickles running through wastes of sand. After heavy rains, however, they become formidable torrents, the waters rising with extraordinary rapidity in a few hours.

The main rivers flow from west to east with a slight inclination towards the south. The following are the main rivers:—

Subarnarekha.
Kasai or Kanshabali.
Silai or Silabati.
Darakeswar.
Damodar.
Ajoy.
Mor or Morakshi.

Besides these main rivers and their larger tributaries, there are countless khals and smaller streams so that the country is well drained and seldom becomes water-logged.

Climate and Rainfall.—This is a dry tract, and scarcity and unequal distribution of rains are frequent so that partial or total failure of crops occurs at frequent intervals. From the middle of March to the beginning of June hot westerly winds prevail—the heat during the day is very oppressive (temperature 105—116 degrees in the shade). Norwesters are frequent during these months. During the rains (June to September) the climate is pleasant, the temperature being comparatively cool and the atmosphere neither heavy nor damp. Rainfall is 50 inches to 60 inches annually. In winter, the minimum early morning temperature is about 56 degrees.

Geology.—The greater portion of this tract is covered by laterite and alluvium. To the east and south, there are large areas of recent alluvium, while metamorphic and gneissose rocks are found to the north and extreme west. The prevailing character of the metamorphic rocks is hornblendic associated with granitoid gneiss. But the most characteristic geological feature is the area of laterite and associated rocks of sands and gravels. In places one finds true laterite in hard massive beds and blocks, in other places laterite gravels. These ferruginous gravels in some places pass by almost imperceptible changes into solid laterite. On the other hand they pass by several gradations into a coarse sandy loam containing only a few of the ferruginous nodules of laterite which give a red tint to the whole. Calcareous *kankar* also is frequently associated with this coarse sandy loam. The general appearance of the laterite rocks is that of a continuous layer spread over the country, swelling here and there with a gently undulating surface. This great sheet of laterite appears invariably to dip under the small alluvial flats on both sides of the long swelling undulations and to rise again beyond them. This deposit is more continuous and thicker towards the east until it is covered up by clays. The thickness of this laterite is variable from 6 to 60 feet. Below this laterite a bed of clay is met with, below which gneiss is found at variable depths. This bed of clay forms the water level of this laterite tract. These long low swells of laterite are chiefly covered with low coppice, with occasional patches of grassy land, but their dry, parched and stony soil is ill adapted for cultivation.

Forest and its Flora.—The uplands are covered in many parts with low jungle, sometimes very dense. This coppice jungle—practically the whole tract now bears second or subsequent growth, the primeval forest does no longer exist—is intermixed in the comparatively inaccessible areas with trees of larger growth; these are mainly in the west and north-west of Midnapore district, and in the south and west of Bankura district. In the remaining areas practically nothing but stunted *sal* coppice remains, all else having given way to the axe of the wood-cutter or to the zeal of the charcoal burner. Owing to the opening up of the country by the railways and its general development, the jungles have from being valueless come to be one of the most prized assets of the owners. As a general practice they are coppiced on a very short rotation—2 to 4 years, though even a rotation of 8 to 9 years is not unknown in some of these less accessible areas.

The coppice forest is exceptionally pure, *sal* (*Shorea robusta*) forming at least 95 per cent. of the crop, with the following associates:—

(1) *Lagerstræmia parviflora* var. *Majuscula* (Sidha).—This coppices freely and is found mostly in the poorer open jungles forming part of the overwood with *sal*.

(2) *Bassia latifolia* (Mohwa), *Dyospyros melanoxylon* (Kendu), *Buchanania latifolia* (Peal), *Terminalias* (Asan, etc.), *Scheleichera trijuga* (Kusum), *Semecarpus anacardium* (Bhela), *Spondias mangifera* (Amra), *Morinda tinctoria* (Ach), *Pterocarpus marsupium* (Peasal), *Adina cordifolia* (Chakalta), *Phyllanthus emblica* (Amla), *Anogeissus latifolia* (Dhau) and *Bombax malabaricum* (Simul), occur either as isolated standards here and there or as coppice or stunted growth intermixed with the *sal* coppice. They seldom form any appreciable percentage of the crop except *Bassia latifolia* and *Dyospyros melanoxylon*, which are spared the axe for their value as fruit trees, and *Pterocarpus marsupium*, a valuable timber tree.

(3) *Cleistanthus collinus* is found as a low coppice, mixed with *sal*, mostly in poorer localities and often on some of the hills, subject to frequent burning and cutting, as pure coppice.

(4) *Gardenia gummifera* (Bhurur) and *Ixera parviflora* (Rangan) form a poor second storey in very open *sal* coppice forest, more or less in a gregarious form, though not infrequently they occur as stunted small isolated trees in better areas.

(5) *Holarrhena antidysenterica* (Kurchi) is another species that occurs both as a sparse low shrub in dense pure *sal* areas or as a dangerous weed competing with all its might to oust the *sal* in poorer and open *sal* coppice jungle.

Woodfordia floribunda (Dadki) is also frequently met with as an under storey in such areas.

(6) The thorny species, such as *Zizyphus conoplia* (Siakul), *Zizyphus jujuba* var. *fruticosa* (Ber.), *Randia dumetorum* (Boibindi) and several others are ever present in the open *sal* coppice forest, their proportion increasing with the progressive deterioration of the *sal* coppice.

(7) *Butea frondosa* (Palash) is more a tree of the waste lands, where practically everything else has been cut down, forming pure gregarious groups in patches here and there, though in the periphery of the deteriorating jungle this species and Kend (*Dyospyros melanoxylon*) are seen to defy the axe and grazing and fire.

(8) Of the climbers, *Combretum decandrum* (Aten), a large scrambling climber, is very conspicuous and occurs all over the poorer and open areas in a more or less bushy form due to frequent coppicing, though when left to itself, it forms high and dense bushes.

Thus these forests have been reduced to coppice or scrub condition, due to action of man, in which the species are exposed to the effects of selective browsing and annual burning. The species which has survived longest are apparently those rich in tannic acid or with a formidable armature of thorns, e.g., almost pure *Cleistanthus* coppice on some of the hills and the fire-resisting species. The abundance of the thorny species in the poorer *sal* coppice areas is mainly a result of selective cutting and grazing, both man and beast avoid them. The

quantity removed for fencing purpose is trifling. In the mixed *sal* forest, the *sal* is the more abundant in proportion to its distance from towns and villages.

The *sal* crop consists mainly of coppice poles of a foot or so in girth and 25 to 30 feet in height. As a general rule older *sal* is seldom met with in these forests, as their retention as standards over coppice is not in great favour, though there are exceptions in certain localities where standards of 3 feet girth by 50 feet high are seen amongst the low coppice. Besides older *sal*, patches of inconsiderable size and in groups along the boundaries of low coppice jungle are also seen in certain localities of Bankura district. Another conspicuous exception is the Nayagram Estate in Midnapore district where a certain amount of *sal* high forest still exists though no sound or valuable tree of 3 feet or more girth can be found, all such trees were removed by successive lessees in the past.

Of the grasses, *Andropogon* (spear grass) and *Saccharum arundinaceum* (Sar) are important; several species of the former occur in the forests and the latter is seen mainly in the vicinity of hamlets and the larger rivers. Bamboos are conspicuous in the forests by their absence, though they are abundant in villages in certain localities only. Few bamboos are grown in the villages as a rule, the villagers find the cheaper and the inferior substitute in young *sal* poles.

APPENDIX V.

Serial No.	Class.*	Rotation in years.	Yield per acre in c.ft.	Revenue per acre per year.	Period after felling when grazing is allowed in years.	Staff.	Expenditure per acre per annum.	Approximate profit per acre per year.
				Rs. a. p.			Rs. a. p.	Rs. a. p.
	Midnapore District.							
1	Large ..	6	Not known ..	Not known ..	2	Not known ..	Not known	Not known.
2	Medium ..	5	Ditto ..	2 8 0 to 3 0 0	3	3 Foresters and 16 guards.	0 2 6	0 7 0
3	Small ..	6	700	7 8 0	Not allowed ..	....	..	..
4	Medium ..	6	Not known ..	Not known ..	2	5 guards ..	0 2 3	..
5	Large ..	10 to 14	2,500 to 3,000	8 0 0	Not allowed ..	2 Foresters and 8 guards.	0 1 3	0 5 0
6	Medium ..	8	800 to 1,000	13 12 0	2½	1 Surveyor and 12 guards.	0 1 9	1 10 0
7	Large ..	8 to 10	1,750 to 2,300	50 0 0 to 80 0 0	3	3 Foresters and 60 guards.	0 3 3	6 7 0
8	Small ..	5	800	20 0 0 to 28 0 0	Not allowed ..	Occasional guard ..	0 8 0	4 0 0
9	Small ..	5	800	20 0 0 to 25 0 0	Ditto ..	6 guards ..	1 4 6	3 9 0
10	Small ..	5	500 to 600	14 4 0	Ditto ..	3 guards ..	0 4 0	2 10 0
11	Large ..	10	1,100	19 4 0	3	1 forester, 2 head guards and 20 guards.	0 1 0	1 13 0
12	Large ..	Not fixed	....	0 4 0	1	Some officers and guards.	0 1 3	0 2 6
	Burdwan District.							
13	Small ..	3 to 5	400 to 500	3 12 0	2	....	..	1 4 0
14	Medium ..	12	690	15 0 0	3	3 part-time officers and 4 guards.	0 6 3	0 14 0
15	Medium ..	5	Not known ..	2 4 0 to 3 0 0	Not allowed ..	17 guards ..	0 3 3	0 5 0
16	Small ..	5	300 to 350	3 0 0 to 3 12 0	1	2 guards ..	0 1 3	0 12 0
17	Small ..	4	300	3 0 0	Always ..	Watchmen ..	Take firewood and graze cattle.	0 12 0
18	Medium ..	5	250	3 0 0	1	Ditto ..	0 1 6	0 8 0
19	Small ..	6 or 7	Not known ..	7 0 0	When new coppice sufficiently big.	Estate peons ..	..	1 0 0
	Birbhum District.							
20	Small ..	7	300	3 8 0	1	1 guard ..	0 1 6	0 10 0
21	Small ..	5	Not known ..	5 0 0	1	....	....	1 0 0
22	Large ..	5	Ditto ..	5 0 0	Always ..	29 guards ..	Not known	0 15 0
23	Small ..	6	300	3 12 0	Ditto ..	None ..	..	0 10 0
24	Small ..	4	Not known ..	10 0 0	Ditto ..	1	0 7 9	2 0 0
25	Medium ..	8 to 10	Ditto ..	Not known	Not allowed ..	4 guards ..	0 1 6	..
	Bankura District.							
26	Medium ..	6	500	6 0 0	Always ..	1 Inspector, 2 Jamadars and 10 guards.	..	..
27	Small ..	3 to 5	300	6 0 0 to 7 8 0	1	2 guards ..	0 1 0	1 11 0
28	Small ..	3 or 4	650	3 0 0 to 4 8 0	3	....	..	1 5 0

*Large means 10,000 acres and over.
Medium means 1,000 to 9,999 acres.
Small means 999 acres and under.

Serial No.	Class.*	Rotation in years.	Yield per acre in c.ft.	Revenue per acre per year.	Period after felling when grazing is allowed in years.	Staff.	Expenditure per acre per annum.	Approximate profit per acre per year.
	Bankura District —*contd.*			Rs. a. p.			Rs. a. p.	Rs. a. p.
29	Small ..	3 or 4	Not known ..	3 0 0 to 4 8 0	2	....	..	1 4 0
30	Small ..	4	Ditto ..	1 2 0	Always ..	1 guard ..	1-8th of profit after deducting rent.	0 4 0
31	Medium ..	5 to 6	480	4 8 0 to 6 0 0	6 months ..	....	..	1 0 0
32	Medium ..	3 or 4	370	2 4 0 to 4 8 0	Always ..	....	..	1 0 0
33	Small ..							
34	Small ..							
35	Small							
36	Small ..							
37	Small ..	3	600	6 8 0 to 9 0 0	1	Guards ..	0 1 3	2 0 0
38	Medium ..	4	800	9 0 0	1	Ditto ..	0 0 3	2 4 0
39	Small ..	3	600	6 8 0 to 9 0 0	1	Ditto ..	0 1 3	2 0 0
40	Small ..	3	600	6 8 0 to 9 0 0	1	Ditto ..	0 11 9	2 0 0
41	Small ..	3	Not known ..	3 10 0	1	....	..	1 3 0
42	Small ..	4	Ditto ..	3 4 0	2	1 guard ..	0 1 0	1 0 0
43	Medium ..	7 or 8	600 to 750	4 8 0 to 6 0 0	2	16 guards ..	..	1
44	Medium ..	10 to 12	Not known ..	9 0 0 to 12 0 0				
45	Medium ..	18 to 20	Ditto	24 0 0 to 30 0 0				
46	Small ..	1	270	0 6 0	Not allowed ..	....	..	0 6 0
47	Medium ..	5 or 6	Not known ..	7 8 0	1	14 or 15 guards ..	0 6 0	1 2 0
48	Small ..	4	Ditto ..	3 12 0	1	....	..	0 15 0
49	Small ..	4	Ditto ..	4 0 0	1	....	..	1 0 0
50	Medium ..	5	300	7 8 0 to 9 0 0	Little grazing ..	....	..	1 11 0
51	Small ..	5	Not known ..	7 8 0 to 9 0 0	Always ..	....	..	1 11 3
52	Medium ..	6 to 15	Ditto ..	11 11 0	Not alllowed ..	8 guards ..	0 4 0	0 12 0
53	Small ..	40	Ditto ..	5 0 0 to 7 0 0	2	21 guards ..	Not known	0 10 0
54	Medium ..	10						
55	Medium ..	Y						
56	Medium ..	6						
57	Large ..	12	Ditto ..	5 0 0	2	Guards ..	Ditto ..	0 7 0
58	Medium ..	5	Ditto ..	3 0 0 to 7 8 0	When sapplings are big	Ditto ..	Ditto ..	1 0 0

*Large means 10,000 acres and over.
Medium means 1,000 to 9,999 acres.
Small means 999 acres and under.

APPENDIX VI.

Part I.

No. 4922, dated (Hinoo) Ranchi, the 1st October 1938.

From—L. R. Sabharwal, Esq., I.F.S., Conservator of Forests, Bihar,
To—The Senior Conservator of Forests, Bengal.

With reference to your letter No. 15573/2M-36, dated the 26th September 1938, I have the honour to forward herewith a copy of the form of lease which has been standardised for execution by the owners of private forests. It contains all the terms on which the forests are leased. The lease generally runs for 35 to 45 years and the rental paid by Government to the owners varies from anna 1 to annas 2 per acre according to the condition of the forests at the time of taking them over.

Draft Standard Agreement Approved by Government.

Memorandum of agreement made this.....day of..... one thousand nine hundred and.....between the Secretary of State for India in Council of the one part and hereinafter called the owner (which expression shall unless there is something repugnant in the context include his heirs, executors, administrators and assigns) of other part:

WHEREAS the owner being the proprietor/tenure-holder of the land situated in villages.....and particularly described in schedule I hereunto annexed has in pursuance of section 38 of the Indian Forest Act, 1927 (hereinafter called the Act) with a view to the conservation of forests on the said land represented in writing to the Deputy Commissioner of Ranchi his desire that the said land be managed on his behalf by the Forest Officer as reserved or protected forest, on terms to be mutually agreed upon and has also intimated his desire that the provisions of Chapter II/Chapter IV of the Act and the provisions including section 2 incidental thereto, or such of the provisions of that chapter as may be thought suitable by the Governor in Council of Bihar and Orissa (hereinafter called the local Government), and such other of the provisions of the Act as may be so thought suitable shall be applied to the said land: AND WHEREAS the local Government are satisfied that such management of the said land upon the terms hereinafter set forth will tend to the public advantage:

NOW IT IS HEREBY MUTUALLY AGREED AND DECLARED that the said land or such portion or portions thereof as the local Government may decide shall be managed direct by the Forest Department by Government upon the terms hereinafter set forth, that is to say:—

I. The several words, terms and expressions to which in the said Act meanings are assigned, shall in this agreement have the same meanings respectively. And the words "The said forest" shall in this agreement mean such portion of the said land as is finally declared by Government to be reserved forest by a notification under section 20 of the Indian Forest Act.

II. The said forest shall remain under the direct management of the local Government for a period of thirty-five/forty years.

III. The local Government may by notification in the *Bihar and Orissa Gazette* apply to the said land or to any portion or portions thereof such provisions of the said Act as from time to time they think suitable to the circumstances thereof.

IV. When section 4 of the Act is applied and a notification is published thereunder in respect of the said land or any portion or portions thereof—

(*i*) the pay and allowances of the Forest Settlement Officer appointed to make the enquiry and determination mentioned in clause (*c*) of the sub-section (1) of the said section in respect of the land so notified shall be payable by the local Government;

(*ii*) the costs of settlement arising under section 11 and of the commutation, if any, under section 16 or section 18 of the Act of any rights affecting the land notified admitted under section 15 shall be payable by the owner; and

(*iii*) the cost of the establishment and contingent expenditure of the Forest Settlement Officer and the cost of surveying and demarcating the said land shall be payable by the owner.

V. When the said land or any portion or portions thereof has or have been constituted a reserved forest the control and management of the forest shall vest solely in the local Government and the local Government shall appoint a Forest Officer in respect of the said land or any portion or portions thereof and shall specify the powers of such officer. The local Government may at any time revoke any such appointment or power.

VI. Subject to the terms of the forest settlement and conditions of this agreement, the Forest Officer shall have full powers of control regarding the treatment of the forests, hereinafter called the said forest, the allotment and regulation of grazing, the felling of trees and removal of all produce and shall have power to close such areas to grazing as he may deem necessary and for such period as he may think fit. He shall inspect the said forest and report thereon to the local Government. He shall prepare a working plan in respect of the said forest showing the manner in which it is to be managed and worked, and he may revise any such working plan.

VII. The local Government shall receive all revenue accruing from the working and management of the forest and shall pay the whole expenditure involved in the operations undertaken by the Forest Department in the management of the said forest and the owner shall have no right to object to any expenditure that the local Government may consider necessary. In addition the local Government shall pay to the owner annually for the first 11 years and triennially for the rest of the period, on or before the first June next following the close of the financial year or the period for which the payment is due a sum equivalent to 2 annas/1½ annas/1 anna per year per acre on the total acreage of the said forest. The net profits, if any, after deduction of this sum and of the costs of administration shall be divided between the local Government and the owner in equal proportions.

VIII. That the following revenue and expenditure accounts shall be maintained and the owner shall not be entitled to dispute the correctness of these accounts:—

(1) On the receipt side of revenue and expenditure account shall be credited all cash and book transfer receipts of every description. On the expenditure or debit side of the revenue and expenditure account shall be entered all cash and book transfer expenditure and the aforesaid annual payment to the owner and such supervision and establishment charge as the local Government may from time to time determine.

(2) When the forests of two or more owners are managed by the same staff, the distribution of the cost of management shall be based on the proportion of the areas of their respective forests provided that special charges incurred solely on account of any individual forest shall be debited to the account of its owner: Provided also that the account of Government forests shall be kept separate from that of the private forests.

(3) The apportionment of revenue derived from forests belonging to two or more owners, when managed by the same staff shall be based on the relative areas of their respective forests provided that their revenue derived solely from any individual forest shall be paid into the account of its owner: Provided also that the account of Government forests shall be kept entirely separate from that of the private forests.

(4) For the purpose of calculating the net profit mentioned in clause VII the following procedure will be adopted:—

(*a*) For the first eleven/ten years the debit balance of one year shall not be carried forward to the next year.

(*b*) For the subsequent period of the lease the account shall be worked on a three-year basis. At the end of each triennial period a balance shall be struck and the accounts shall be closed and the profits, if any, divided as mentioned above and the debit balance, if any, shall not be carried forward to the next triennial period.

(5) That a copy of the yearly revenue and expenditure account for the said forest shall be sent to the owner on or before the first of June each year for the first eleven/ten years and thereafter on or before the first of June following the close of each triennial period: Provided always that capital expenditure on roads and buildings to be made within the estate of the owner shall be treated separately from all other expenditure, that a separate account shall be maintained of such capital expenditure, that such capital expenditure shall be deducted in such instalments as the local Government may fix over a period not exceeding the period of the lease from the amount of the net profits available for division between the local Government and the owner and that no interest shall be charged by the Government on such capital expenditure.

IX. (1) The local Government shall not make any charge against the owner on account of any functions performed under clause VI of this agreement or for the service of the Forest Officer for a period of eleven/ten years from the date of this agreement. During the twenty-four/thirty years next following the owner shall be liable to pay triennially for the services of the Forest Officer a contribution equal

to 12½ per cent. of the profits which accrued in the previous triennial period; or the proper share of the Forest Officer's pay and allowances as determined by sub-clause (2), whichever is less.

(2) The cost of the Forest Officer's pay and allowances shall be distributed by the Conservator of Forests over the several forests under his charge in such manner as the Conservator of Forests may think fair, having regard to the respective areas of the forests.

X. The Forest Officer shall on demand of the owner allow him to remove such timber or other produce as he may require for his reasonable domestic use or consumption provided that in no case shall this right be exercised so as to necessitate a deviation from the working plan, departure from the prescribed annual yield or interference with the exercise of rights under the forest settlement: Provided also that the value of such timber and other forest produce removed shall be calculated on the basis of the schedule of rates for the time being in force for the sale of forest produce from the reserved forests of Palamau Division and shall be charged against the owner and debited to his account: Provided also that the value of any timber or other forest produce so removed may be set off against any rent payable to the owner under clause VII.

XI. The local Government will not interfere with the rights of shooting in these forests by the owner or his nominee.

XII. The local Government will permit the owner to erect *bundhs* at suitable places at his own cost inside the said forest if he desired to do so for the purpose of irrigating land outside the said forest.

XIII. The local Government will as far as possible exclude land fit for reclamation as rice land at the time of demarcating the said forest: Provided that in so doing the said forest is not honeycombed with cultivation and the cost likely to be incurred for demarcating and maintaining the additional boundary lines required to exclude rice lands will not be excessive and provided further that the said exclusion will not unduly complicate the task of administering the said forest.

XIV. For each of the forest guards and peons appointed the owner shall convey to the Forest Department by a registered agreement two acres of conveniently situated land suitable for the cultivation of the winter rice to be given as service *jagirs* to forest guards and peons so appointed. At the termination of the period under this agreement such lands will be reconveyed to the owner by the Forest Department by registered deed.

XV. The owner shall be permitted to cultivate lac on such *kusum* and other lac host trees as may be left as standards in the said forests.

XVI. Nothing contained in this agreement shall be deemed to derogate from the power of the local Government by notification in the *Bihar and Orissa Gazette* made in exercise of the powers of the local Government under section 38 of the said Act or to alter or to cancel at their discretion any notification issued under the said Act or to issue any other notification, acquire the forest or the land therein or any part of it under any law for the time being in force for the acquisition of lands: Provided always that in case of such an acquisition the market value will not be determined solely on the basis of the yearly payment agreed to be made hereunder.

XVII. If any difference of opinion arises between the owner and the Forest Officer or the Forest Department as to the interpretation of this agreement the decision of the local Government shall be final and conclusive.

As witness the hand of.....on behalf of the owner .....and the hand of the Secretary to the Government of Bihar and Orissa in the Revenue Department for and on behalf of the Government of Bihar and Orissa in Council acting in the premises for and on behalf of the Secretary of State for India in Council the day and the year first above written.

SCHEDULE.

* * * * * * *

Part II.

Note on the private forests of Bihar taken over by Government under section 38 of the Indian Forest Act, 1927.

Area.—Since 1930 an area of 215,540 acres of private forest has been taken over by the Bihar Government under section 38 of the Indian Forest Act and is managed by the Forest Department in accordance with the terms of the standard agreement.

Rent.—The rent paid by Government to the proprietor depends upon the period of the lease, the area of the forest, the quality of the crop, the demand for timber and firewood and the distance from markets.

Isolated blocks of forest, usually heavily burdened with rights and cut up by cultivation, are not as a rule taken over by Government.

Reserved and Protected Forest.—The main policy is to reserve the better forests, which are less heavily burdened with rights and to manage the remainder as protected forest.

Where the demands of right-holders can be satisfied with little difficulty from the normal annual coupe, reservation rather than protection is indicated. Where, however, the rights are so extensive that after satisfying them there would be little forest produce remaining from the annual coupe for commercial purposes, the forest is constituted a protected forest, the intention being to allow for the exercise of rights with the minimum interference, as the rules for protected forests are less stringent than for reserved forests.

Forest Settlement.—No Forest Settlement Officer is appointed for the protected forests; with the reserves on the other hand the Forest Settlement Officer deals with the rights in accordance with the provisions of Chapter II of the Act. Rights are restricted to those found at the time of settlement and no account is taken of a possible increase in population or number of cattle.

Settlement records are prepared separately for each village to show in detail the quantity of timber, firewood and the number of cattle, and the forest in which the rights may be exercised.

The standard allowances of timber and firewood are 9 cubic feet and 168 cubic feet (stacked) per household annually. Experience shows that these allowances are probably in excess of the actual needs of the right-holders. The exercise of rights in reserved forests is subject to the provisions of any working plan or scheme which has been approved by Government, and so far as timber and firewood are concerned subject to the further condition that the material is available from the annual coupe.

Rights to minor forest produce such as jungle fibres or edible roots are also controlled by rules made by the Forest Department.

The clearing and burning of the undergrowth and the collection of dead and dry firewood, outside the annual coupe, is prohibited.

Rotations.—The rotations in Bihar are considerably longer than in Western Bengal, varying from 30 to 60 years. The reason for this is the heavier demand for timber for house building and agricultural implements and for pit-props and sleepers for the mines.

Closure to grazing.—Normally young woods are closed to grazing for eight years after felling. With the longer rotations this is possible without affecting the right-holders to any great extent, since about 75 per cent. of the forest is always open.

Financial results.—So far all the forests have run at a loss, which is borne by Government, in accordance with the terms of the agreement.

APPENDIX VII.

Part I.

A Note on the preparation of a working plan suitable for the Sal forests in Western Bengal.

1. *General principles.*—The forest capital consists of the soil or fixed capital and the growing stock or accumulating capital.

Sound management rests on the conservation of the forest capital, and it follows therefore that first the fertility of the soil must be maintained and secondly when any growing stock is removed in fellings it must be replaced by a new crop.

Subject to these general principles the working plan should aim at systematic exploitation, the production of the type of forest produce best suited to the market or to the objects of management and improvement in the quality and density of stocking.

It is usually desirable so to arrange fellings that approximately equal annual quantities are placed on the market, thereby ensuring a more or less steady income. Such an arrangement is known technically as management on the basis of a steady annual yield. With

small forests it may not be possible to base management on an annual yield; and intermittent working giving approximately equal yields at longer intervals may be best suited to these forests.

2. *Demarcation and division of the forest area.*—The first step in the preparation of a working plan is to demarcate the forest area which will come under the provisions of the plan. In Western Bengal demarcation need not be elaborate and the boundaries of the forest can conveniently be shown by placing a tar ring round the stems of trees selected at regular intervals.

Where cattle grazing is a factor which is causing the gradual deterioration of the forest on the edges, it is particularly important to have the forest boundary demarcated in order to ascertain the rate at which the forest area is contracting under the influence of cattle grazing.

It may be assumed that normally only areas which can be classified as Sal forest will be exploited and that areas containing mainly miscellaneous species, possibly with a few scattered Sal trees, will not be subjected to systematic working.

In any event the management to be applied to these two types will be essentially different, and the second step must be the investigation of each wood with a view to its classification according to type.

3. *Working circles.*—The unit of treatment is known as a Working Circle and in any forest all the Sal woods would constitute one working circle and the miscellaneous woods a second working circle.

During the process of inspection, note should be made of the quality, age and density of stocking. This information is required to ensure, first, that all the best areas are not felled over in the early stages and, secondly, that where great intensity of management is desirable the annual yields are equalised by felling in suitable proportions each year areas which are densely stocked or which yield good quality timber and areas which are stocked badly or with inferior trees. It will usually suffice to distinguish density and quality by having a few broad classes under each head, such as "good", "medium" and "poor".

4. *Felling Series.*—With large forest estates it may be desirable to arrange that the annual coupe is not confined to one part of the forest. Several lines of export may be available and different markets may have to be supplied. It may therefore be necessary to subdivide the Working Circle into what are known as Felling Series.

The Felling Series is the unit of yield prescription. For example a working circle comprising 9,000 acres might be divided into 3 Felling Series of 2,000, 3,000 and 4,000 acres. Separate yields would be calculated for each series and with a rotation of 10 years the annual normal yield would be 200, 300 and 400 acres, respectively. The subdivision of the working circle is often of advantage in that forest staff can be allotted regular work each year.

5. *Silvicultural system.*—The term silvicultural system is used to describe the process by which the crop is tended, removed and replaced by a new crop and is more or less synonymous with the method of regeneration. The main market for Sal in Western Bengal is Calcutta, where there is a keen demand for firewood and small poles, and a long rotation is not required for the production of these. The fact that Sal, up to middle age, has the power to regenerate itself vigorously from

coppice shoots makes it possible to adopt the system of simple coppice and to take area as the basis of yield prescription.

Reliance on coppice shoots alone for the replacement of growing stock removed in fellings is not sufficient. After repeated coppicing the Sal tree loses its power of producing vigorous shoots and, as time goes on, the coppice becomes whippy until at last the rootstock dies. It is clear that unless some measures are taken to replace the dying rootstocks the crop will thin out, the soil will become exposed and the fixed capital will be reduced.

The only method by which the soil can be preserved is to retain at each felling a number of seed trees and thus ensure that at all times seedling growth is available to take the place of dying rootstocks.

The Sal tree does not produce fertile seed in early youth, and seed trees must remain unfelled until they have performd the functions for which they were reserved. In Western Bengal it will be sufficient to retain the seed trees for three rotations of the coppice or until they are 30-35 years of age.

Whenever the coppice is felled one tree per bigha should be kept, so that there is an overwood of seed trees aged say 10, 20 and 30 years under a coppice rotation of 10 years. The seed trees require to be carefully selected so that they are uniformly scattered over the area and are healthy, with good crowns and of good form, and that their value as posts when they are eventually felled may thus be high.

At each felling those seed trees, which have been left standing for three rotations of coppice, will be felled and new seed trees will be reserved from the coppice crop to take their place.

Seed trees should be marked with tar rings to indicate their age, i.e., those newly reserved with one ring, those which have stood for two rotations with two rings and those which have remained for three rotations with three rings.

6. *Rotation.*—The minimum rotation, if the soil is to be protected, in Western Bengal is 10-12 years according to the quality of the soil. On good soils the growth is faster and the shorter rotation can be adopted. The disadvantage of a very short rotation is that the soil is exposed at frequent intervals, and surface erosion to a certain extent is inevitable at each exposure. With long rotations the soil gets a period of rest during which fresh soil is built up by means of the humus resulting from the decay of the fallen leaves, etc.

Where it is necessary to lengthen the rotation say from 4 years to 12 years, it is not essential that the process should be done in one step. For example with a Felling Series consisting of 9,600 acres, the size of the annual coupe would be:—

With a rotation of—

Years.	Acres.
4	... 2,400
6	... 1,600
8	... 1,200
12	... 800

During a period of thirty years, by reducing the size of the annual coupe at intervals, the rotation can be lengthened without risk of a

very serious loss in income, the size of the coupe being less by 25-33 per cent. at each stage. If this reduction is combined with proper tending of the new crops, the quality and volume per acre should increase and go some way towards maintaining income.

7. *Method of felling.*—One of the essential measures to be taken for successful regeneration by simple coppice is the proper cutting of the rootstock. The trees should be felled at a height not greater than 6″—9″ so that the new coppice shoots may arise from adventitious buds situated near the base of the stool. If this is done there is a possibility that some of the coppice shoots may develop their own root systems and became independent of the rootstock from which they originated. This will be an additional measure offsetting the dying of the old rootstocks, which necessitates the reservation of seed trees.

The adventitious shoots are stimulated by the felling and their development must not be interfered with by a further cutting of the stool.

Fellings should be completed by the middle of April just before the growing season commences, to give the new shoot a full period of growth in the first year.

Except for the seed trees which have to be reserved all trees, irrespective of species, must be clear-felled. The miscellaneous species should in most cases be felled at a greater height than the Sal in order to discourage their growth in favour of the more valuable Sal.

Experience shows that after felling operations have been completed better results are obtained if the felling area is burnt and all brushwood, etc., removed by this means. A warning must, however, be given against delay in setting fire to the coupe. This must be done as soon as the felling operations are complete and early in the day before the debris has dried out so that an intense fire may be avoided. This might seriously damage the seed trees and kill the adventitious buds from which the coppice shoots originate.

8. *Protection and tending of the new crop.*—The question whether the new crops will be of better quality and density than the original crop depends entirely on whether the proprietor is prepared to re-invest a small part of the proceeds realised from sales in his forests. Without adequate tending and protection the new crop is not only likely to be no better than the original one, but may even be inferior.

So far as protection is concerned the two factors, which must be taken into account, are damage from cattle and danger of fire. The whole vitality of a plant is bound up with the photosynthesis, which goes on in the leaves, and if cattle are allowed to browse on young coppice the shoots cannot develop and both the rootstock and shoots may die. Cattle grazing is usually concentrated on the edges of woods and the results are evident everywhere in Western Bengal, where the boundary of the forest is gradually being pushed back and the Sal replaced by scrubby Kendu and Palash.

Fencing is out of the question and the only action possible is to proceed against offenders.

The period during which young coppice must be protected from fire extends to four or five years until the shoots have put on a thick corky bark which makes them immune to damage from any fire of slight intensity. The measures which can be taken to afford protection

consist in punishment of those convicted of deliberate arson or carelessness. In forests where fires are of common occurrence it may be necessary to take special measures, for example the recruitment of fire-watchers and the keeping of a strip round the edges of the regeneration cleared of all inflammable material during the fire season.

In Western Bengal on the whole climbers are not very numerous. Nevertheless the expenditure of a rupee or two per acre to keep down climbers by systematic cutting may be necessary in some cases.

Similarly where the number of shoots per stool is very great resulting in an intense struggle for light between individual stems, it may be necessary to reduce the number of shoots per stool to not more than 3 or 4. The reduction should be done in the 4th or 5th year.

If tending operations are to be a feature of the working plan, it is essential that a systematic scheme should be drawn up, indicating the years in which each operation is to be carried on.

9. *Records and control.*—Certain operations in a working plan are prescribed in the sense that they are subject to audit. The most important working plan prescription is the yield or, in the case of a system of simple coppice, the area which it is permitted to fell over annually.

It is essential that this prescription should be audited.

Where climber cutting or any other tending operation is an important feature, it would be desirable that this also should be subject to audit.

The audit of working plan prescriptions is done by means of what are called Control Forms, in which the results of actual working are compared at the end of each working year with what has been laid down in the working plan.

So far as the yield prescription is concerned it is neither necessary nor desirable that the yield should be rigidly adhered to. A certain degree of latitude must be allowed in order to enable the proprietor to adjust the quantity of forest produce placed on the market with the quantity which can be absorbed at a reasonable price. The great danger is that a proprietor may be tempted to fell year after year, in excess of the prescribed yield thereby nullifying the objects of the Control Form. Provided that the excess felling is not abnormally great, say not more than 20 per cent. in any one year, and provided that the excess is worked off in subsequent years, so that no area is felled over more than once in a rotation, the principles of sound management cannot be said to have been departed from.

In addition to the maintenance of Control Forms, to see that all the important prescriptions of the plan are adhered to, it is desirable that certain other records should be maintained in the form of what is known as a Compartment History.

This record is not obligatory, but is usually worth maintaining. In the Compartment History are entered the details of sale prices and wherever possible an accurate return of the quantities of material removed. Notes of the occurrence of anything which will affect the silvicultural state of the crop, such as damage from fire, climber-cutting and other tending operations should also be maintained. It is only by systematically recording outturn that it will be possible to obtain reliable information as to whether the value of the forest is increasing under management.

A knowledge of the volume to be expected also assists the proprietor in judging what will be a fair price to accept for a coupe at auctions.

In this connection the closest possible touch with market rates, costs of felling and extraction and freight should be maintained, as in many cases offers far below what are reasonable are accepted at auctions.

Specimen Control Form for the yield prescription.

Felling Series.....

Prescribed yield.....acres per annum.

Year of Working.	Area worked.		Excess or deficit of the year.		Total excess or deficit to date.	
	Locality.	Area.	Excess.	Deficit.	Excess.	Deficit.
1	2	3	4	5	6	7
		Acres.	Acres.	Acres.	Acres.	Acres.

.....

Signature of officer submitting return.

Date.....

.....

Signature of officer sanctioning the deviation from the prescribed yield.

Date.....

Specimen Compartment History.

(First page.)

Results of working.

Locality.	Year of working.	Area worked.	Sale price.	Outturn.	
				Posts.	Firewood.
1	2	3	4	5	6
				No.	c.ft.

(Second page.)

History.

Year.	Month.	Particulars.	Area.	Expenditure.
1	2	3	4	5

Part II.

Note on the working plan for the Dhalbhum Forest in Bihar.

Area and legal position.—The forests are the property of the Dhalbhum Raj Estate, the proprietor of which applied under section 38 of the Indian Forest Act, 1927, for the forests to be taken over by Government.

The greater part of the forests were gazetted as reserved forest and the balance as protected forest:—

Notification, No. and date.	Area, acres.	Status.
No. 3200-VI. F.-4R., dated the 26th July 1937 ..	106,134·40	Reserved.
No. 3118-VI. F.-68/38R., dated the 11th April 1938	14,163·29	Protected.
	120,297·69	

The reserved forests are situated in 239 villages and the protected forests in 94 villages.

Rights of user.—The rights of user were enquired into by a Forest Settlement Officer and settlement records were prepared separately for each village, copies of which are given in an appendix to the plan.

Villages, which were not accommodated in reserved forest, were given rights in protected forest specially constituted for the purpose.

Sheep and goat grazing have been prohibited both in reserved and protected forest, as also has the collection of dead and dry fuel outside the annual coupe.

The exercise of rights is subject to the provisions of the plan and so far as timber and firewood is concerned is further subject to the condition that it is available from the annual coupe.

The clearing and burning of the undergrowth is prohibited and the exercise of rights to collect jungle fibres, edible fruits and roots is subject to control by rules.

The standard allowance per household per annum is 9 cubic feet of timber and 168 cubic feet of stacked fuel.

Composition and condition of the crop.—The crop is generally very poor and open, having been ruthlessly cut and over-grazed in the past.

The principal species is *sal* with its usual associates. Most of the trees are mal-formed, largely due to the high stumps left under the unregulated fellings of the past.

In the plains parts of the forest, where the rural population is numerous, the destruction of the forests has been more or less complete.

Injuries to which the crop is liable.—The theft of forest produce, deliberate firing of the forest and uncontrolled grazing are the greatest causes of damage.

Markets.—The localities in which the forests are situated are fairly heavily populated and much of the demand is local, principally timber for house building and agricultural implements and for firewood. The Indian Copper Corporation also used a large quantity of pit-props, sleepers and green poles of miscellaneous species in the refinery.

The Calcutta market absorbs any surplus poles and firewood.

Future management prescribed under the plan.

General objects of management.—The general objects of management are—

(*a*) to improve the silvicultural state of the crop, particularly with reference to the prevention of erosion;

(*b*) to meet the demands of right-holders;

(*c*) to produce timber fit for house building, agricultural timber and pit-props; and

(*d*) to produce firewood.

Working plan period.—The working plan has been drawn up for a period of ten years.

Working circles.—Since the general treatment of the forests is uniform, only one working circle has been formed.

Silvicultural system.—The immediate aim is to replace the poor irregular crop, which has resulted from mismanagement in the past, by a healthy uniform crop.

A method of coppice regeneration with the reservation of seed-trees is suited to the species and will produce the type of material in demand.

Rotation.—The rotation has been fixed at 30 years, which is considered long enough to give the size of timber required for house building, agricultural implements and pit-props, and which is not considered too long to assure adequate coppice reproduction.

In certain areas, where the crop has suffered very badly, it is essential to replace the ruined crop as quickly as possible and in these areas the rotation has been reduced to 10 years during the working plan period.

At least 8—10 standards per acre must be reserved as seed-trees.

Felling Series.—The basis of the formation of Felling Series was convenience of control and of right-holders. The size of the Felling Series has been kept to the maximum consistent with efficient supervision by a Forest Guard; that is to say each series forms a sub-beat. Further, the Felling Series are so arrangd that the right-holders of a village or group of adjacent villages are dependent on a particular series for their requirements.

The number of Felling Series is as follows:—

(*a*) Reserved Forest free from rights to timber and fuel, 25 series.

(*b*) Reserved Forest burdened with rights to timber and fuel, 6 series.

(*c*) Protected Forest, burdened with rights, 14 series.

Felling Plan.—No detailed Felling Plan, showing the actual areas to be felled each year, has been drawn up. The selection of the sites for the annual coupes has been left to the Regional Forest Officer, who is limited merely by the annual yield prescribed for each series. The general direction in which fellings should progress over the area is, however, indicated on the working plan maps.

Yield prescriptions.—The yield has been prescribed separately for each series, specifying the maximum number of acres which may be felled over each year.

Method of executing fellings.—In the Felling Series, which are free from rights to timber and firewood, the annual coupes are to be demarcated and sold by auction in the ordinary way. In the series burdened with rights, in the first year the coupe is opened to the right-holders and the balance is not auctioned until the second year. Except that 8-10 seed trees per acre must be left standing, the annual coupe must be clear-felled and no stump higher than 6″ is permitted.

Control of right-holders' fellings.—The following provisional rules have been framed, but have not yet received the approval of Government and may be modified considerably:—

(1) The annual coupes are to be open to right-holders only during the months of November, April and the first half of May;

(2) Right-holders may not remove their timber or fuel except under the direct supervision of the Forest Guard in charge of the Felling Series;

(3) The coupe is to be divided into sections, and right-holders must fell systematically across the coupe, one section being completed before another is opened;

(4) The village headman is responsible for preparing a statement for submission to the Range Officer showing the quantities which each right-holder is entitled to take during the coming working season. This statement is prepared between August and October;

(5) After check the Range Officer will issue permits (in triplicate) for each right-holder. One copy is sent to the village headman for forwarding to the right-holder; one copy is sent to the Forest Guard and the third is kept as an office record;

(6) In October the Forest Guard is to attend village panchayats to ascertain that each right-holder has received his permit and that there are no disputes about quantities, and to arrange dates on which the villagers will go to the coupe;

(7) The village headman must be present at the time of felling to identify the right-holders, who must bring their permits with them; and

(8) After the 15th May the Forest Guard will return his copies of the permits, filled in with the quantities of forest produce actually removed by each right-holder. The Range Officer will check the quantities, and enter the abstracts in registers.

Cultural operations.—No detailed plan of cultural operations has been included in the plan. Such measures as cleaning and burning the annual coupe, after fellings have been completed, climber cutting and the thinning out of the young coppice have been left to the discretion of the Regional Forest Officer. Climbers will however be cut as far as possible before coupes are opened to felling.

Closure to grazing.—The annual coupes are to be closed to grazing for 8 years after felling.

Miscellaneous regulations.—The collection of dead and dry fuel outside the annual coupe is prohibited.

Boundaries are to be cleared on a three year cycle and one fifth of the boundaries are to be inspected by a responsible officer each year.

For fire protection 21 patrols are to be maintained during the period 1st February to 31st May.

Staff.—The staff consists of 2 Forest Rangers, each with a clerk, and an average area of 94 square miles of forest; 5 Foresters with an average of 38 square miles and 38 Forest Guards each with an average of 5 square miles.

Range.	Beat.	No. of sub-beats.	Staff.
Upper Subarnarekha.	.... ..		1 Forest Ranger. 1 Clerk.
	Mahulia ..	8	1 Forester. 8 Forest Guards.
	Kalikapur ..	8	1 Forester. 8 Forest Guards.
	Musabani	6	1 Forester. 6 Forest Guards.

Range.	Beat.	No. of sub-beats.	Staff.
Lower Subarnarekha.	.... ..	..	1 Forest Ranger. 1 Clerk.
	Dumaria ..	9	1 Forester. 9 Forest Guards.
	Chakulia ..	7	1 Forester. 7 Forest Guards.

Appendices.—There are nine Appendices:—

I. Copies of Gazette notifications.

II. Copy of the agreement between the proprietor and the Bihar Government.

III. Abstract of the record-of-rights.

(*a*) *Reserves burdened with rights to timber and firewood.*

No. of reserves 6, comprising	14,314 acres.
No. of villages	62
No. of cows	5,456
No. of buffaloes	693
No. of households entitled to timber ..	2,505
Quantity of timber at 9 c.ft.	22,545 c.ft.
No. of households entitled to fuel	2,281
Quantity of firewood at 168 c. ft.	383,208 c.ft.

(*b*) *Reserves free from rights to timber and fuel.*

No. of reserves 25, comprising	91,817 acres.
No. of villages	74
No. of cows	6,631
No. of buffaloes	560

It may be noted that the average number of cattle per village is nearly 100 and per household between 2 and 3.

The average demand for timber and firewood from the annual coupes amounts to 42 c.ft. and 804 c.ft. per acre.

IV. Statement showing the division of the forest area into Felling Series and the yield prescribed for each.

V. Specimens of the permits to be issued to right-holders and of the registers to be maintained.

VI. A triennial scheme of boundary clearing.

VII. A quinquennial scheme of boundary inspection.

VIII. Details of the fire protection scheme.

IX. Details of the charges of Forest Ranger, Foresters and Forest Guards.

APPENDIX VIII.

The Cultivation of Sabai Grass.

The following is an extract from United Provinces Forest Department Leaflet No. 9 of June, 1938, on Baib (Sabai) grass plantation in the United Provinces:—

Propagation.

"4. The baib (Sabai) is best propagated vegetatively by rootstocks which can be either collected from the adjoining forest or taken out from a nursery. The lead of rootstocks to most plains areas involves prohibitive transport costs. It is therefore recommended to raise local stock by seed in nurseries.

Nursery Technique.

"5. The nursery site should be well-drained and accessible. The baib (Sabai) thrives best on sandy loams and loamy sands, commonly known as better types of bhur soils. The nursery should be dug about a foot deep and the soil allowed to weather for some time. It should then be thoroughly broken up and worked. All roots and tufts of grasses should be collected and carefully burnt. With the break of the monsoon (or the commencement of irrigation) all extraneous grass seeds lying in the soil should germinate within a fortnight. These grasses should then be systematically pulled out and removed. The soil should be levelled and the baib (Sabai) seed admixed with sand should be lightly sown. Wait for a break in the monsoon for the sowing of seed, otherwise it is apt to be washed away. Keep nursery beds weeded clear throughout the rains. As a matter of fact, very little weeding will be necessary if all extraneous grasses are carefully pulled out and eliminated before sowing.

Plantation.

"6. (*i*) *Site.*—Well-drained sandy loam areas are eminently suited to the cultivation of baib (Sabai). Water-logging and overhead shade check its growth and must be avoided.

"7. (*ii*) *Soil preparation.*—The soil should be thoroughly ploughed up and worked sometime in April and allowed to weather through the summer. All grass tufts and vegetable matter should be dug out and carefully burnt. At the break of rains, wait for a fortnight or so, until the grass seeds and roots, still lying in the area, germinate. These should be systematically pulled out and eradicated. The soil should be ploughed up once again and levelled.

"8. (*iii*) *Planting.*—Baib (Sabai) from nurseries should now be put out 2 feet by 2 feet.* All that is needed is to introduce small tufts with roots into planting holes made at the time of planting with a spade. The soil when filled back in the holes should be tightly packed around the tufts and finished slightly higher than the ground level to avoid water-logging.

*In the South Kheri Division, Mr. Bansal tried various distances at which baib (Sabai) was spaced. The best results were obtained with 2 × 2 feet. The yield fell with a closer spacing, while a wider spacing led to the invasion of grasses.

"9. (*iv*) *Weeding.*—The secret of baib (Sabai) cultivation lies in clean weeding. Left to itself, baib (Sabai) is unable to compete with other grasses, and it is for this reason that it has been driven to most inhospitable tracts. A systematic rooting out of all grasses before planting especially kans and spear grass makes subsequent weeding less intense and frequent. Two weedings during the rains will generally suffice. In subsequent years a thorough weeding immediately before each cutting is all that is required.

"10. (*v*) *Protection*—(*a*) *Animals.*—Young fresh shoots of baib (Sabai) are readily eaten by wild animals and also by cattle. At a later stage it is not generally eaten. It is liable to damage by pigs, porcupines and white ants.

"11. (*b*) *Fire.*—No precautions against fire are necessary. As a matter of fact experience in Bihar indicates that it is beneficial to the growth of baib (Sabai) to burn the area in May (2nd year) and repeat the burning every year.

Rate of Growth.

"12. By the end of October, baib (Sabai) reaches a height of about 1½ to 2 feet. The grass is ready for cutting by the middle of the following July, i.e., when it is about 12 months old. It yields a second crop again during November-December.

"13. The yield varies with the soil. In the South Kheri Division the average yield of both crops is about 40 maunds per acre. At Ujhani in Budaun District on bhur soil with a spacing of 3 feet × 3 feet the yield has averaged about 20 maunds per acre.

Financial Returns.

"14. (*a*) *Expenditure.*—Figures of cost of soil working and weeding are available only under forest conditions, where labour is scarce and hoeing has to be resorted to instead of ploughing. The South Kheri plantations cost as under:—

	Per acre. Rs.
1st hoeing (April)	12
2nd hoeing (June)	8
Collection of rootstocks	8
Planting	12
Weeding costs (2)	10
Incidental charges	10
Total Expenditure ...	60

"15. (*b*) *Income.*—The following year the grass is ready for cutting. The average yield with proper attention should be about one ton per acre. Baib (Sabai) in South Kheri is sold for about 12 annas per maund. In view of the proposed extensive cultivation of baib (Sabai) and consequent increase in future supplies, it should be safe to assume the price of baib (Sabai) as 8 annas a maund, so producing an income of about 13-8 per acree."

APPENDIX IX.

Cultivation of Napier Grass.

DEPARTMENT OF AGRICULTURE, BENGAL.

(A)

Leaflet No. 10 of 1931 (revised in 1939).

Napier grass is a native of South Africa. It is a perennial and very quick-growing fodder crop. When mature, it grows to a height of about 10 feet and looks somewhat like a crop of thin sugarcane. Its stems are also hard like those of sugarcane.

Its cultivation was introduced into this Province for the first time in the year 1927 by the Department of Agriculture, Bengal, and after successive trials it has been found to be the heaviest yielding fodder crop that has yet been discovered. Cattle and young stock relish it greatly and it is undoubtedly nutritious.

Suitable land for Napier grass and its preparation.

Napier grass must be grown on high well-drained land not subject to water-logging. The land should be thoroughly cultivated either by an iron-plough or by "kodali" to a depth of at least 6 inches, and brought to a fine tilth by subsequent operations.

Manuring.

For a crop like Napier grass which is both a quick grower and a heavy yielder, it is obvious that much of the plantfood in the soil gets exhausted and the land in which it is planted must therefore be well manured. Before planting on all soils, cowdung or rotted water-hyacinth at the rate of 75 maunds per bigha is required. This is sufficient on grey silt soils (poli mati). On red soils the following should also be applied:—

(1) Lime—5 maunds per bigha.
(2) Bonemeal—3 maunds per bigha.
(3) Water-hyacinth ash—10 maunds per bigha.

If water-hyacinth ash is not available sulphate of potash or chloride of potash at the rate of 16½ seers per bigha may be substituted.

Time of planting.

Provided there is sufficient moisture either from rain or irrigation, Napier grass may be planted at any time of the year excepting in the months from November to February.

Method of propagation.

Like sugarcane the stems of mature Napier grass are cut into setts for planting which is the best method of propagation. Planting should be done in rows 3 feet apart and cuttings planted 2 feet apart in the rows. Two cuttings should be planted together and lightly covered with earth.

The best way is to germinate the cuttings like sugarcane in a seed bed and then plant them out, but in the monsoon ungerminated setts may be planted. If germinated setts are planted they are less liable to be attacked by white ants.

Number of cuttings required per bigha.

Approximately 5,000 cuttings per bigha are required if the above procedure is followed.

Subsequent operations.

After germination, the land should be kept free from weeds and after rain or irrigation, should be hoed or cultivated with a bullock grubber or with a planet junior cultivator, before the surface hardens. This will keep the moisture in the soil to be utilised by the rapidly growing crop.

Harvesting.

It has been said above that Napier grass is a perennial crop and grows to a height of 10 feet. But for fodder, the best stage to cut it is when it is at a height of about 3 feet 6 inches. In the hot weather or monsoon the crop grows to a height of 3 feet in 6 weeks or so, after planting, and thereafter cutting may be made every two months. The plants should be cut close to the ground and the stems left should never be longer than 1 inch, otherwise the yield will diminish at once.

Manuring after harvesting.

As the first harvesting goes on, the land should be immediately manured with 25 seers of Niciphos per bigha; then the land should be well hoed and if necessary weeded. After the second harvesting apply 75 maunds of cowdung or rotted water-hyacinth per bigha and then hoe. And so on alternately.

Outturn.

On an average with the above treatment, a good cutting may be taken every 2 months and without irrigation, each outturn may be expected to average 120 maunds per bigha or, say, 650 maunds of first class fodder per bigha per annum. With irrigation up to double this yield may be expected.

Conclusion.

The significance of the above results should be realised. Assuming that a full grown cow of good size requires 20 seers a day of good green fodder like Napier grass, she will consume 183 maunds a year. A bigha of land producing 660 maunds of Napier grass can, therefore, keep 3½ full grown animals. With such a fodder crop, the problem of milk supply for large towns can be solved without difficulty and in the country districts the largely increased supply of milk can be turned into ghee, cheese, casein, lactose, etc. In fact, Napier grass, well cultivated, holds great possibilities for increasing the income of the cultivators and, therefore, of enriching the country at large.

(B)

Extract from the article in "Some Wireless Talks on Agriculture", 1933.

Silage.

It has been said before that Napier grass can be stored as silage. This is done by storing the green grass in silos. As Mr. D. Clouston, Agricultural Adviser to the Government of India, wrote in a magazine article—"There are definite types of silos in use in Government farms and on the military dairy farms in India; but they may be divided roughly into two classes, viz., (1) *'pucca' and* (2) *'kutcha' silos.* The former are, perhaps, too expensive except for the well-to-do land-owners. The *'kutcha'* silo, on the other hand, which consists merely of a pit in which the fooder is stored in the green state and covered with a thick layer of earth, costs very little and is well within the means of the ordinary ryot. Such silos are in use on many Government farms in this country. At the Imperial Cattle-breeding Farm at Karnal pits dug in the heavy alluvium soil and filled four years ago with green *juar* were opened last cold weather; the ensilage at the end of four years was found perfectly sweet and good. This method of storing fodder in the green state, when it is abundant and not required for immediate use, should in course of time commend itself to the more enterprising agriculturists of the country. It is a method which, if adopted by stock-owners, would enable them to provide their cattle with a luscious food for the dry weather when grazing areas are parched and bare." Silage can easily be made with Napier grass.

APPENDIX X.

The estimated cost of control of each Region is (1) capital outlay of Rs. 18,450 and of which details are given in Statement B and (2) annual recurring expenditure of about Rs. 30,150 inclusive of leave and pension charges of which details are given in Statement C. For the two Regions proposed in Western Bengal the total expenditure would not exceed Rs. 37,000 on capital outlay and an annual charge of Rs. 60,000.

Statement A.

Strength of Forest Staff in each Region.

Designation.	Rank.	No.	Duties.
Regional Forest Officer	Gazetted officer on senior scale of pay.	1	General administration and compilation of working plans for vested forests and scrutiny of plans for controlled forests, etc.
Range officer ..	Forest Ranger ..	2	In charge of a Forest Range, inspection of forests and dealing with forest offences, including acceptance of compensation, collection of field data for working plans.
Beat officer ..	Foresters and Deputy Rangers.	4	Similar to those of the Range officer, except that no power to compound forest offences is given.
Clerical establishment	Head Clerk ..	1	....
	Assistant clerk ..	1	Typing, filing, despatching.
Menial establishment	Regional Forest Officer's orderlies.	2	....
	Range officer's orderlies.	2	....
	Office peon ..	1	....
	Dak wallah ..	2	

Statement B.

Capital outlay (non-recurring) per Region.

I—Buildings.

	Rs.	Rs.
1 Regional Forest office at Rs. 3,000	3,000	
2 Range office and quarters at Rs. 2,000	4,000	
4 Beat office and quarters at Rs. 1,000	4,000	
2 Clerks' quarters at Rs. 850	1,700	
7 Menials quarters at Rs. 500	3,500	
		16,200

II—Office furniture.

1 Regional Forest office at Rs. 250	250	
2 Range offices at Rs. 100	200	
4 Beat offices at Rs. 75	300	
		750

III—Stores, etc.

1 Typewriter at Rs. 350	350	
Survey instruments, etc. (say)	650	
Tents (say)	500	
		1,500
Total capital outlay		18,450

Statement C.

Recurring charges, per Region.

A—Conservancy and maintenance.

Budget Sub-head.	Rs.	Rs.
A iii c—Upkeep and replacement of stores (say)	100	
A iii e—Upkeep of buildings at 6 per cent. (say)	1,200	
A v d—Law charges (say)	100	
A v f—Clothing (say)	200	
A v g—Miscellaneous (say)	250	
		1,850

B—Establishment.

Budget Sub-head.		Rs.	Rs.
B i b—Superior staff—1 at Rs. 450—800 per month ..		7,500	
B ii a—Subordinate Executive staff—			
	Rs.		
2 Forest Rangers at Rs. 60—175	2,820		
4 Foresters or Deputy Rangers at Rs. 30—55 ..	2,040		
		4,860	
B ii b—Clerical Establishment—			
1 Head clerk at Rs. 80—150	1,380		
1 Assistant clerk at Rs. 35—80	690		
		2,070	
B ii c—7 Menial Establishment at Rs. 16—20		1,512	
B ii d—Leave allowances at 14 per cent. of B ii a, b and c ..		1,151	
B iii a—Travelling allowance—*			
1 Regional Forest officer at Rs. 2,500 ..	2,500		
2 Range officers at Rs. 1,000	2,000		
4 Beat officers at Rs. 500	2,000		
5 Menials at Rs. 120	720		
		7,220	
			24,313
B iv a—Stationery (say)		200	
B iv b—Carriage of tents (say)		200	
B iv c—Rents, rates and taxes (say)		100	
B iv d—Service stamps (say)		300	
B iv e—Sundries (say)		187	
			987
			27,150
The above excludes—			
(*i*) Leave and pension charges on superior staff (say) ..		2,000	
(*ii*) Pension charges of permanent subordinate and clerical staff		1,000	
			3,000
Grand total		..	30,150

*In view of the work required to be done expenditure under this head will be high.

APPENDIX XI.

Forest Law in relation to private forests.

Most of following information has been obtained from "Forestry and State Control" by R. S. Troup, C.M.G., C.I.E., D.Sc., F.R.S., Professor of Forestry in the University of Oxford (Clarendon Press, 1938).

The following tabular statement, from which it will be seen that private forests play a predominant part in the majority of European countries, gives the percentage distribution of forests under different categories in 1932:—

Country.	Forest area as percentage of total land area.	Ownership.		
		State or Crown.	Communal or public corporation.	Private and company.
	Per cent.	Per cent.	Per cent.	Per cent.
Austria ..	37·7	24·1	8·6	67·3
Belgium ..	18·2	5·7	32·3	62·0
Czechoslovakia ..	34·3	11·3	24·8	63·9
Denmark ..	9·0(*a*)	24·0	29·0	47·0
Esthonia ..	..	80·0	..	..
Finland ..	73·5(*b*)	39·8	1·7	58·5(*c*)
German Reich ..	24·0	32·6	19·5	47·9
Great Britain (*d*) ..	5·6	12·3(*e*)	1·3	86·4
Greece ..	18·5	80·0	..	Small
Hungary ..	12·7	..	..	..
Italy ..	19·5	3·0	32·0	65·0
Latvia ..	26·8	83·6	1·8	14·6
Netherlands ..	8·0	30·6	..	69·4
Norway ..	21·4	15·0	7·0	78·0
Poland ..	22·8	31·7	0·9	67·4
Portugal ..	22·0	..	..	..
Rumania ..	24·2	29·5	30·7	39·8
Russia (European) ..	44·0	100·0	..	..
Spain ..	14·0	..	..	..
Sweden ..	55·0(*b*)	37·5	1·9	60·6
Switzerland ..	22·7	5·0	70·6(*f*)	25·0
Yugoslavia ..	..	47·0	19·0	34·0

(*a*) Excludes scrub, park-land and poor coppice, which occupies 9 per cent. of the combined forest and scrubland.
(*b*) Productive forest only.
(*c*) Includes 7·6 per cent owned by Companies.
(*d*) Corrected to 1937.
(*e*) Woodland and planted area, excludes land acquired but not yet afforested.
(*f*) Includes forest owned by Cantons.

In European countries there has recently been a tendency towards increased ownership by the State, partly due to the increasing importance attached to the maintenance of protection forests under immediate State management, partly due to a feeling that State management means greater security in the matter of timber supplies and national defence, and in certain cases to the introduction of forms of government which put nationalization in the forefront of general policy.

State ownership, however, was not always looked on with favour. Towards the end of the eighteenth century and during part of the nineteenth century the area of State forest showed a marked decrease, possible under the influence of the doctrine of individual rights and non-interference by government preached by Adam Smith. This tendency was particularly marked in France after the Revolution, in parts of Prussia and some of the Scandinavian countries. The release of control over private forests in the northern parts of Europe resulted in the devastation of many forest areas, particularly on the barren sandy soils of the north-east.

Acquisition by the State of private forests for protective purposes has frequently taken place in the past, while at the present time acquisition of forest for production purposes and of land for afforestation is proceeding in several countries. In Czechoslovakia and the Baltic States the area of State forests has been considerably increased since 1920 by the compulsory expropriation of private forest land.

In some cases the acquisition of private forests is regarded as the only practicable method of safeguarding the future maintenance of forests. In this respect the policy followed at one time by the United States in the matter of alienation of forest land affords an interesting comparison with that followed by Canada and the results are instructive.

In Canada over 90 per cent. of the forest land has been retained as public forest land under State control and in the United States nearly 80 per cent. has been alienated to private ownership.

In the latter country the Weeks Act of 1911 provided for the acquisition of private forest land by the Forest Department, primarily for the protection of catchment areas. In 1924 an amendment to the Clarke-McNary Act extended this power to the purchase of forest lands for timber production. In 1933 the Coupland Report recommended the acquisition of 134 million acres of forest land, subsequently reduced to 131 million acres by the Report of the National Resources Board. In addition acquisitions totalling 228 million acres are contemplated by other federal agencies. All this shows how undue alienation of forest land may involve a country in vast expenditure on its repurchase. Canada, although she may yet be faced with a large bill for regeneration of depleted forest, will be saved the expenses of re-acquiring the land on which they grow.

The extent to which it may be necessary for the State to intervene depends on a variety of factors. The general principle that a private owner should not use his property in such a way as to injure another party is well founded and so far as "protection forests" are concerned it is usually admitted that this principle is applicable. In most countries containing mountainous regions and other tracts in which the maintenance of protection forests is important, the law has long imposed restrictions where none were applicable to forests in general.

The following remarks by Professor Troup refer to the desirability of extending State control over private forests on the ground that no country can afford to neglect the duty of safeguarding its future timber supplies.

> "The factor, which above all others, may render State control advisable is the time element, which introduces an essential difference between forestry and agriculture. Whereas most

> agricultural crops are harvested within a year of sowing the production of large-sized timber requires a period of time ordinarily extending over the life-time of several generations of individuals. Forestry practised by private individuals, therefore tends to concentrate on short-rotation crops rather than on the production of large timber, and the latter is regarded more particularly as the function of the State. ***** Sound forestry implies sustained yield management with a correct distribution of age-classes from the youngest to the mature stand. It requires continuity of managment extending over a long period of time and demands the constant attention of a trained and competent manager. These conditions may be fulfilled by one owner or even a succession of owners, but the time must inevitably come when through extravagance, ill-fortune or other causes, the continuity is broken and over-cutting and devastation occur."

As has been shown, attention is being directed more and more to the evils which result from the loss of surface soil when faulty methods of land utilization are employed either in agriculture or forestry. It is, therefore, because private forestry is attended by a risk of over-cutting, when the owner is in difficulties, that there is a growing realisation of the need for something more than the creation of "protection forests" on mountain tops and in catchment areas.

Considerations such as these have led most European countries to pass legislation ensuring some measure of control over private forests. "It is significant that in Germany the yields per acre from private forests under Government control are on the average nearly if not quite as high as those of the State forests, while in the case of uncontrolled forests not only are the yields less than half those of State forests, but the timber produced is of smaller size." (Troup).

The following is a brief summary of the law in relation to private forests in some of the more important European countries, for further details reference should be made to Professor Troup's book.

Great Britain.—Owing to her insular position, her good sea communications and her strong mercantile marine, Great Britain has long relied on imported supplies for meeting the bulk of her timber requirements, less than 5 per cent. of which are met from home-grown sources. It was not until after the Great War that any serious attempts were made to study the position of home-grown timber supplies in Great Britain.

As a result of the Acland Report, published towards the end of the War, a Forestry Act was passed in 1919. This Act was concerned with measures felt necessary to ensure that Great Britain should be independent of imported timber for a period of three years in the event of another national emergency. Up to 1937 the Forestry Commissioners had acquired a total area of 885,451 acres of which 557,685 acres consisted of plantable land, and had afforested 316,548 acres (including replacements).

There is no control over private forests in Britain, except in the case of entailed property, when the owner is prevented under the law of entail from cutting down his woods without an effort to replace them, except with the sanction of the heir-at-law.

In 1931 the question of private forestry in Great Britain was the subject of inquiry by the Forestry Consultative Committees of England, Scotland and Wales. A joint report by these three Committees ascribed the decline of private forestry to various factors, including the general depression, taxation, the break-up of estates, the high level of wages, and the want of confidence in the future, which prevents proprietors from sinking capital in such long-term investments as plantations. The report was unable to suggest any practical solution of the questions in view of the need for national economy at a time of serious financial depression, and the Forestry Commissioners have foreshadowed the possibility of maintaining the woodlands of Great Britain by taking them over on fair terms where, after every possible encouragement and State co-operation has been offered, the owner is unable to re-plant.

State assistance is provided by the Forestry Commissioners—

(1) by encouraging planting by local authorities and private persons with the aid of grants from the State,
(2) by furnishing advice on technical matters,
(3) by subsidizing education and research and
(4) by contributing in other ways towards the assistance of forestry.

The afforestation grants paid by the Forestry Commission amount to a maximum of £2 per acre for conifers, £4 for oak and ash, £3 for beech, sycamore or chestnut, and £2 for other approved hardwoods. These grants have been an incentive to planting to a limited exient only; between 1920 and 1936 only a little over 111,000 acres, which represents about one quarter of the area estimated to have been felled during or immediately after the war, was replanted.

Austria.—Under the Forest Act of 1852 no private forest land might be diverted to any other purpose without the permission of the Local Civil Authority and then only after full inquiry. State and Communal forests had to be regenerated within five years; in private forests a longer time was permissible provided failure to regenerate was not deliberate.

All forests had to be managed on the basis of a sustained yield and where forests were burdened with rights these had to be regulated in the interests of the correct silvicultural treatment of the forest. Strict rules were laid down to regulate grazing, the removal of leaf-litter and branchwood. Removal of litter was permitted only once in three years from any particular area.

Private forests over a certain size had to be managed by a professionally trained manager, approved by the State, and the local State Forest Officer was required to supervise management.

Protection forests were under special regulations. Since the absorption of Austria in the German Reich, it is presumed that the German Law is now applicable to Austria.

Czechoslovakia.—After the break up of the Austro-Hungarian Empire at the end of the War, a new and stricter law relating to private forests was passed in 1928 and brought into force by Decree No. 97 of 1930. Under this law, subject to certain exceptions, all private forests over 50 hectares (124 acres) must be managed under a working plan, going into

full details of management, drawn up by a qualified officer and approved by authority. Deviations from the prescriptions of the working plan require the sanction of competent authority. Even where an approved working plan is not compulsory, restrictions are placed on the maximum area which may be felled annually. Save in exceptional cases a minimum rotation is fixed at 60 years for high forest, 20 years for oak-bark coppice and 10 years for other coppice. The regeneration of felled areas is compulsory and a private owner may be required to deposit security to ensure this.

Apart from penalties (fine or imprisonment), for serious breach of the law or where reasonable fear exists that a breach may be repeated, the Ministry of Agriculture may cause an estate to be placed under the administration of the Forest Department at the owner's expense.

Private forest owners are required to maintain records to show full particulars of all fellings and works of regeneration, and extracts of these records have to be submitted to the controlling officer within three months of the completion of any felling.

Protection forests are under special legislation, though the tendency is towards doing away with the distinction and to insist on all private forests being properly managed. With small protection forests, where the employment of a trained manager is not justifiable, management can be undertaken by the State Forest Officer on payment of a fee to cover management costs.

Denmark.—The forests of Denmark comprise only 9 per cent. of the total land surface, for the most part in scattered blocks, and 47 per cent. of the forests are under private ownership.

The first Forest Act was passed in 1805, which placed all forests, irrespective of ownership, in a "reserved" category and provided for their maintenance in perpetuity as high forests.

The law was amended and modernized in 1935 (Law No. 164 of the 11th May 1935) and the extent of State control was clearly defined. State Forest Inspectors are responsible for seeing that private owners carry out the provisions of the Act, breaches of which are punishable with heavy fines.

The main provisions of the Act of 1935 are—

(1) It applies to all forests "reserved" under the Act of 1805 and to all others reserved since that date. (There are in fact very few forests private or other not included in the category of "reserved forests").

(2) Reserved forests must be maintained as high-forest as opposed to coppice; tending must be in accordance with the silvicultural needs of the crop. Adequate arrangements must be made for regeneration, owners must give proper attention to such operations as draining, where necessary, weeding and the upkeep of forest roads; and the planting of conifers in the place of hardwoods is prohibited, if it would result in the decrease of the area under the latter species.

(3) The State Forest Inspectors, often officers of the Forest Department who draw an allowance for doing the work in addition to their normal duties, have powers of inspection and are required to give technical advice and directions to the private forest owners within their jurisdiction and to see that their instructions on technical matters are carried out.

(4) An appeal against the orders of a State Forest Inspector is provided for. The appellate board consists of—

(*a*) A member of the Ministry of Agriculture;

(*b*) The head of the State Forest Department;

(*c*) The Chief Inspector of Sand Dunes; and

(*d*) Four members of various private forest owners' associations.

(5) Every sale or purchase of private forest land must be notified at once to the Forest Inspector and until this formality has been completed, no fellings or timber sales are permitted.

(6) Any newly afforested land or plantation can be "Reserved" at the option of the owner. The advantage lies in the lower rate of taxes applicable to "reserved" forest and the protection afforded against the inroads of a spendthrift heir.

(7) Provision is made for the removal of any private forest from the "reserved" category on the following grounds:—

(*a*) where it can be shown that the land is too poor to support high forest;

(*b*) if the land is required for building or a public purpose; and

(*c*) in exchange for an equal area of arable land, planted up and "reserved".

Inspections by the State Inspectors are usually confined to one a year, though surprise visits at short notice tend to keep the private owner up to the mark. Small estates may combine to form Associations, which can under certain conditions obtain State assistance. In this way small owners are enabled to obtain expert assistance, trained staff and help at cheap rates.

Finland.—Most of the best forest land in Finland is privately owned and State control in the interest of the country's great timber industry is of special importance.

The Forest Act of 1866, while imposing certain restrictions, was inadequate in practice and it was not until Finland became independent in 1917 that effective control over private forests was instituted. The Act of 1919 gave wide powers of control to the State, mainly in the direction of preventing felling without adequate assurance of regeneration.

On the 11th May 1928 a special Act relating to Private Forests was passed. Under this Act the country was divided into District and Communal areas, each under a Forestry Board, whose duties included not only the enforcement of legislation but propaganda and advice.

The chief provisions of this Act are—

(1) Forest may not be mismanaged (devastated) either by felling in such a manner as to hinder or prevent regeneration, or in the case of young woods by improper or excessive thinning.

(2) Forests, which have been mismanaged in this way, must be closed for a period necessary to regenerate them or, if they are young woods, to provide the requisite period of rest.

(3) The procedure is as follows:—

(*a*) The first step is for the Communal Forestry Board to ask the owner to execute an agreement to carry out the necessary measures, failing which

(*b*) the District Forestry Board can order an inspection to be made by a trained officer, assisted by two members of the Communal Board and require a full and detailed report to be submitted to show exactly what measures should be taken to remedy damage done by mismanagement. The District Forestry Board then calls upon the owner to execute an agreement to carry out the work, failing which

(*c*) the case is referred to a court of law, which is competent to order the necessary measures to be undertaken, if necessary, by the District Forestry or Communal Board at the owner's cost.

(*d*) Communal and District Forestry Boards have the power to issue an injunction against further felling in a forest which has been mismanaged, pending the excution of an agreement by the owner or the order or the court, as the case may be.

(4) Punishment for failing to comply with the provisions of the agreement or to adhere to an injunction issued by a Communal or District Forestry Board is by fine. Any timber illegaly felled is confiscated, or, if it has been sold, its market value has to be paid by the owner to the District or Communal Board and the money is used for propaganda and other work.

(5) Forestry Boards consist of 3 to 5 members and an equal number of deputies. One of the members of the board must be a nominee of the Central Forestry Association; the others are nominated by Agriculural and Forestry Societies of the District.

(6) Prior notice of intention to fell must be given to the Communal Forestry Board, except where management is prescribed under an approved working plan.

Communal and District Forstry Boards have a large measure of freedom, but since they are subsidized by the State they are under the general supervision of the State Board of Forestry, and so far as the expenditure of funds and the application of the law are concerned under the control of the Forest Department.

Members and deputies of the Boards receive no salary, but are paid a fee for each meeting (about twenty each year) and travelling allowance.

Characteristic features of the Finnish organization are the extent to which control is decentralized and the public spirit shown by those serving on the Forestry Boards without regular remuneration.

An organization of this sort would not be possible in any country where the people had not developed a high appreciation of the need to conserve their forest wealth.

The Forestry Boards are bound to employ at least one university-trained forest officer and the necessary number of trained Forest Rangers. In addition there are a number of local Forestry Associations, under which owners combine and employ trained forest-staff on a co-operative basis for the efficient management of their forests. Payment is made on an area basis with fees for special services. These Forestry Associations are entirely separate from the State Boards, and are particularly useful in enabling the small owner, who cannot afford trained staff of his own, to obtain expert help.

France.—Although France has 65·2 per cent. of its forests under private ownership, the only state control is in connection with "protection" forests, for which special provisions are made in the Code Forestier.

Under Article 219 no private forest owner may deforest any area without giving four months' notice in advance to the Civil Authorities. The proposal may be vetoed for any of the following reasons and, if this happens, no clearing of the land is permitted for ten years from the date of the order:—

(*a*) the protection of mountain-tops and slopes;

(*b*) the prevention of erosion, landslips, floods, etc.;

(*c*) the preservation of water-supplies;

(*d*) the stabilization of sand-dunes and sea coasts;

(*e*) national defence; or

(*f*) public health.

There are, however, other important provisions in the Code Forestier relating to private forests, particularly in respect of rights of user.

Under Article 118 a private forest owner has the same right to extinguish rights of user, as are in force for the State forests—

(1) rights to timber may be extinguished by "cantonnement" or the setting aside a part of the forest for the specific purpose of providing for such rights; and

(2) all other rights may be extinguished by the payment of compensation to the right-holders.

Only the owners, not the right-holders, have the right to insist on the extinction of rights of user. If voluntary agreement cannot be reached between the owner and the right-holders, the decision rests with specially appointed tribunals.

Under Article 119 rights to grazing may be exercised only in such parts of a private forest as may be declared open by the Forest Department, and then only to an extent considered compatible with the state of the forest and its silvicultural needs.

Article 120 provides for the regulation of the exercise of right of user in private forests in the same way as in State Forests. The rules refer mainly to grazing, and provide for a limitation of the period during which grazing may be allowed, the appointment of proper cowherds, the carrying of bells and identification marks by cattle, and special restrictions on leaf-eaters, such as goats, etc.

Forest staff employed by private owners have no powers of a Forest Officer, except where the "Garde particulier" has been appointed with the approval of the Civil Authority and even then only with reference to breaches of the Game Laws.

Germany.—Before the Nazi regime the majority of the private forests were not subject to centralized State control; the various States had their own separate Forest Departments and forest laws and the degree of control varied considerably in the different States.

Speaking generally the extent of control was limited to regulations applicable to "protection" of mountain tops, slopes and catchment areas, and for the prohibition of deforestation of areas without previous approval of the State authorities.

Shortly after the end of the Great War an attempt was made to introduce a stricter control over private forests in Prussia, but the bill was thrown out and the only advance made was the compulsory afforestation of cleared forest areas. A second attempt in 1920 to introduce control for the whole of the country was again unsuccessful; but the matter was not dropped.

Under the Nazi Government, the desire to make Germany as far as possible self-supporting has resulted in a policy of reducing timber imports to a minimum with corresponding tightening of the legislation regarding private forests, the yield from which was low in comparison with State forests. To this end the forest administration of Germany has been centralized at Berlin by the establishment of an Imperial Forest Officer (Reichsforstamt) with a Secretary for Forestry (Reichsforstmeister) in charge, and the State Forestry Departments are now subordinate to the central authority.

So far as private forests are concerned the Law of the 18th January 1934 is the most important and is applicable to all forests not belonging to the State. Its main provisions are—

(1) it prohibits the clear-felling of coniferous woods under 50 years of age, or the thinning of such stands to less than one-half full normal stocking;

(2) it prescribes the maximum area for felling in any year on the basis of the area of the forest—

*Areas between 25 acres and 125 acres—5 per cent. of the area.

Areas between 125 acres and 250 acres—3·3 per cent. of the area.

Areas over 250 acres—2·5 per cent. of the area.

(3) Areas clear-felled must be re-afforested at the owner's expense within two years or with the permission of the authorities within a period up to four years.

Italy.—Although in Italy only 3 per cent. of the forests are owned by the State, little attempt was made in the past to control private and communal forests, until in 1910 legislation was passed, making it obligatory on communes and private owners to re-afforest denuded areas in the hilly districts.

**Note.*—The area referred to is the area under a single working plan, or, where no plan has been drawn up, the area for which a working plan is indicated.

The Forest Code of 1923, passed by the Fascist Government is concerned largely, but not exclusively, with forest preservation and reclamation work in the hilly districts. Regulations have, however, been passed to ensure that private forests are efficiently supervised and managed. The main objects of the Forest Code are—

(1) to counteract soil erosion and regulate water supplies,

(2) to develop rural economy in mountain districts and improve arable and pasture lands, and

(3) to co-ordinate works of amelioration with reclamation of denuded areas.

State assistance is given in the form of loans to private persons and public bodies for afforestation works, allowing long periods for repayment: in addition private persons may be subsidized up to two-thirds of the cost of works of afforestation in hilly districts and be allowed exemption from taxation on the land in question for periods from fifteen to forty years.

In 1926 a further law was passed placing all forests under the general supervision of a National Forest Militia, having partly military and partly technical functions, which has taken the place of the former Royal Forestry Corps.

Norway.—Norway has a very high proportion of its forests under private ownership, many of which belong to timber companies. The law of October the 12th, 1857, and various subsequent enactments dealt with the administration of forest and its disposal to forest corporations, the regulation of forest rights and other matters. Under the law of July 1893, dealing with protection forests and devastation generally, district forest officers were empowered to issue instructions, subject to royal assent, for the treatment of both protection and other forests in their districts.

The latest legislation consists of the Forest Protection Act of the 12th February 1932, with subsequent amendments of June 1935 and June 1936.

The organization is somewhat similar to that of Finland, consisting of three supervisory authorities—

(1) the Forest Councils with district supervisory officers,

(2) the Divisional Board of Forestry, and

(3) the Forestry Commission.

The Forest Council, usually one to each district, consists of three resident members with a knowledge of forestry, appointed for three years, and at least two of whom must be forest owners of the district. There are in addition three deputy members.

The Chairman and his Deputy are appointed by the Division Board of Forestry, the second member and his deputy by the district administration and the third member and his Deputy by the district association of forest owners.

The district supervisory officers are men with a practical knowledge of forestry and as much theoretical knowledge as possible and are appointed by the District Forest Council. They are paid by the municipality or parish; but so long as the supervision is satisfactory the State meets three-fourths of their salary for protection forests and one-half for other forests.

If supervision is unsatisfactory the Divisional Board of Forestry may appoint and pay officers as a temporary measure. The Supervisory officers are under the immediate control of the Forest Councils, but instructions to them must be approved by the Divisional Boards.

The latter consists of a committee of five and one District Board is normally set up for each Division (county). The appointment is for three years and the members must be acquainted with local forest conditions. The Boards are assisted by professionally trained forest officers appointed by themselves, subject to approval by the Forestry Commission which decides on their number, and their salaries and expenses are shared by the State and the Division, each contributing half.

The Forestry Commission is the final authority for carrying out the provisions of the Forest Act and for this purpose issues instruction through the Divisional Boards. Before control measures are applied the person affected has a right of appeal to higher authority.

The main provisions of the Act of 1932 and its amendments are:—

(1) So long as the supervisory authority is satisfied that the owner is managing his forest properly, he is entitled to mark trees for felling himself; but no felling in young woods, incompatible with their silvicultural requirements, is permitted except on the following grounds:—

(*a*) that timber is required for household use; but in this case dead trees, windfalls, etc., must be utilized first, if this would not disproportionately increase expense;

(*b*) that fellings have been approved by the supervisory authority under a working plan or as being consistent with sound management.

(2) Intention to fell conifers for sale or industrial purposes must be reported, before marking, to the supervisor within a period fixed by the latter. The report must state the area in which fellings will be made and the type and the approximate extent of felling. All trees must be marked before felling and in certain cases the supervisor may modify the proposals of the forest owner.

(3) By a standing order of the Forestry Commission, local Forest Councils may prohibit all grazing or grazing by certain domestic animals for specific periods of the year, except between the 15th June and 1st October. Goat-grazing may nevertheless be prohibited for the whole year, and so may all grazing where regeneration is endangered.

(4) Where felling has been so heavy and of such a character that the conservation of the forest is endangered, the supervisory authority may order the owner to carry out such operations as may be considered reasonable and necessary for regeneration. The order must specify the period in which these operations must be completed.

Before issuing a definite order, the authorities make every endeavour to reach an amicable agreement with the owner. Any agreement between the owner and the authorities is binding on the future owners of the forest, in the event of sale or inheritance.

(5) Responsibility for re-planting rests on the owner; if fellings are made by another person or on another person's account, he too is held partly responsible, but this does not relieve the owner of the forest of his responsibility.

Where compliance with the law would involve extensive and costly operations, the supervisory authority is empowered to demand security from the owner and prohibit further fellings until adequate security is furnished.

(6) Even where forests have been damaged by fire, storms, etc., the owner may be required to undertake re-afforestation within a reasonable time.

(7) If satisfactory progress is not being made or if there is reason to suppose that the owner will not carry out orders, the supervisory authority can undertake the work at the owner's cost. The estimate of expenses in this event must be sent to the Divisional Board for approval, after which actual costs can be recovered, if necessary by distraint.

(8) If a forest is so mismanaged that the supervisory authority fears that careless felling may prevent satisfactory regeneration or render it difficult within a reasonable time, the Forestry Commission may declare the forest to be "endangered". More stringent restrictions on the felling of trees then become applicable.

(9) Special regulations are included in the Act in respect of protection fellings, mainly in making fellings absolutely subservient to the functions for which the forest has been declared a protection forest.

A further measure to ensure that forests under exploitation shall be regenerated is provided by a "Planting Tax". The tax is payable on all timber felled for sale or industrial purposes at the rate of 1 per cent. of the gross value of the timber and can be recovered, if necessary, by distraint.

The Forest Council maintains a record to show the amount of tax paid by each forest owner, and restores to him the sum which he proves to have been expended on regeneration and other works of a cultural nature.

Deforestation for the conversion of forest into arable land, meadows, building sites, etc., requires the prior sanction of the supervisory authority, which can prescribe the period within which the conversion must be done; and failure to comply may result in an order to re-afforest the land in question.

Sweden.—Sweden too has a large proportion of its forests privately owned. Although there have been forest laws in force since the sixteenth century, the first consolidated Forest Act dates from 1905. This required the replacement of timber felled by regeneration within a reasonable period.

The demand for timber during the Great War led to over-exploitation and caused new legislation to be enacted. The law in relation to private forests is contained in the following three statutes:—

(1) Statute of the 18th June 1915, concerning the working of forests, chiefly in Lapland, where owing to climatic and other conditions the rate of growth is very slow;

(2) The Act of the 24th July 1923, concerning protection forests; and

(3) the Act of the 15th June 1923 concerning forest management.

The latter Act of 1923 is the most important in so far as Sweden as a whole is concerned. Its chief object is to secure the proper management and conservation of all forests, irrespective of ownership.

It restricts felling to old woods and limits the yield to the amount compatible with the conservation of the forest. Immature forests, that is to say, those less than sixty years of age, may be cut only in properly regulated thinnings. Exceptions are made in the case of farms or estates having no older timber, when what is required for estate purposes may be felled with the permission of the Forestry Board.

The organization for carrying out the provisions is, like that in other Scandinavian countries, a system of local Forestry Boards, of which there are twenty-five, one for each county.

Each board consists of a chairman, appointed by the King in Council, and two members, appointed by the County Agricultural Society and the County Council.

To each Forestry Board is attached a Forest Officer and a forest staff and the boards carry out their duties with the aid of money grants obtained by a special tax of 1·3 per cent. of the "stumpage value" of the timber, i.e., the value of the standing crop.

Switzerland.—In Switzerland about 75 per cent. of the forests are protection forests, owing to the mountainous nature of the country, and the control of private forests is mainly concerned with the stabilization of soil at high elevations and the conservation of water supplies.

The determination of what forests are to be classified as protection forests rests with the Canton, subject to federal sanction.

Among the provisions of this protective legislation are—

(1) compulsory demarcation;

(2) prohibition, as a general rule, of clear-felling;

(3) limitation of the incidence of grazing in mountain pastures;

(4) extinction of harmful rights of user, such as the removal of litter, etc.;

(5) the grouping together of private forests, treated as protection forests, for purposes of effective management by the Forest Department, the costs of which are borne by the Canton;

(6) prohibition of deforestation for conversion of the land for other purposes, without the permission of the Federal Council;

(7) commercial exploitation to be subject to permission of the Canton authorities, and

(8) need to have export and extraction roads properly constructed, reinforced and maintained to prevent scouring by water.

Contributions towards the cost of protective work on private estates, such as afforestation, reinforcement of roads, drainage, retaining walls against avalanches, landslips, etc., are made by the Federal Council and the Canton.

Summary.—The extent to which European countries have found it necessary to impose restriction on private forest owners varies considerably.

In the Scandinavian countries in which the timber industry is of great economical importance, private forests are more or less completely controlled in so far as legislation insists on an adherence to the broad principles of sound forest management.

In Germany similar action has been taken, though on different grounds, namely, in order to make the country as self-supporting as possible, largely a military measure. In Great Britain, while control of private forests is not a feature of policy, the expenditure of large sums of money on the acquisition of land for afforestation is justifiable on grounds of military necessity in the event of war.

In pactically all countries of Europe special attention has been paid to the protection of the soil in mountainous districts and the maintenance of water-supplies, and it is becoming more and more evident that a tendency is growing up to enlarge the scope of protective measures to cover erosion generally and not merely the protection of hilly country and catchment areas.

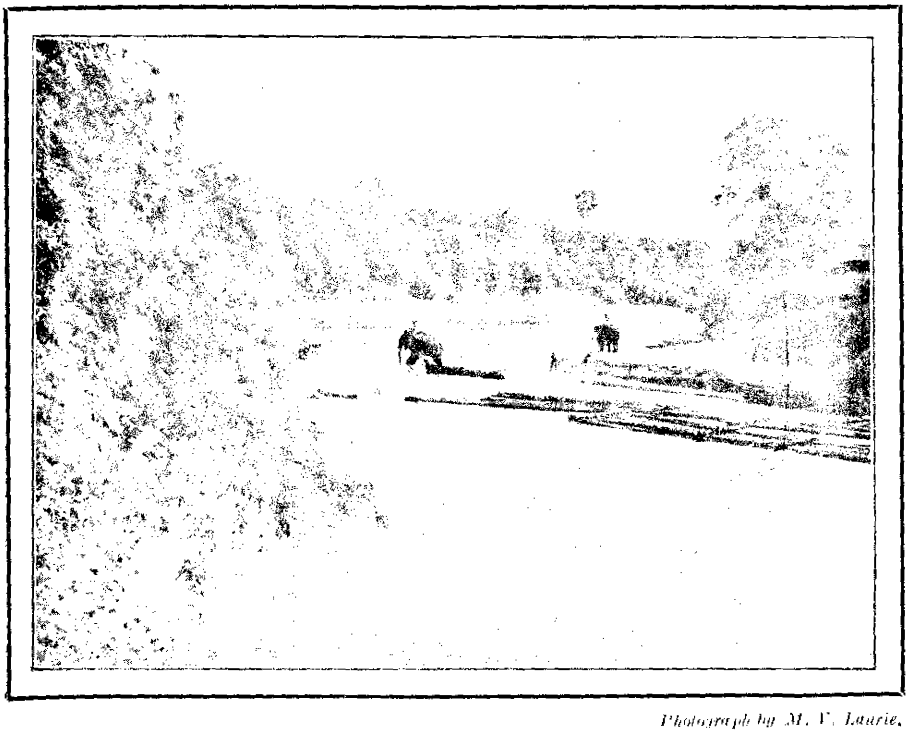
The methods and agency by which effect is given to policy vary with the conditions in each country, more particularly with what may be called the "forest education" of the people. In the Scandinavian countries, where the people have a high degree of appreciation of the economic value of forest conservation, largely due to the fact that one of the main industries in these countries is timber, the organization is highly decentralized.

In most countries it is recognised that it is impossible to carry out policy without (1) reserve powers to punish breaches of the law and (2) State assistance in some form or another, either by subsidies or the maintenance of Regional Forest Officers with staff at Government expense.

In certain cases private forest owners are called upon to contribute to the cost of giving effect to forest policy in the form of taxes, which are, however, not more than 1-1½ per cent. of the sale value of the timber exploited for commercial purposes.

One of the surest ways, in which legislation passed in the interests of the public generally can be made less unpopular is to foster the growth of Associations of Private Forest-owners giving them facilities for obtaining expert advice and help, and even monetary assistance, so that forest education among the people in general may gradually be built up and eventually it may be unnecessary to enforce the law in its full rigour, as the public come to realise that forest policy is designed for their benefit.

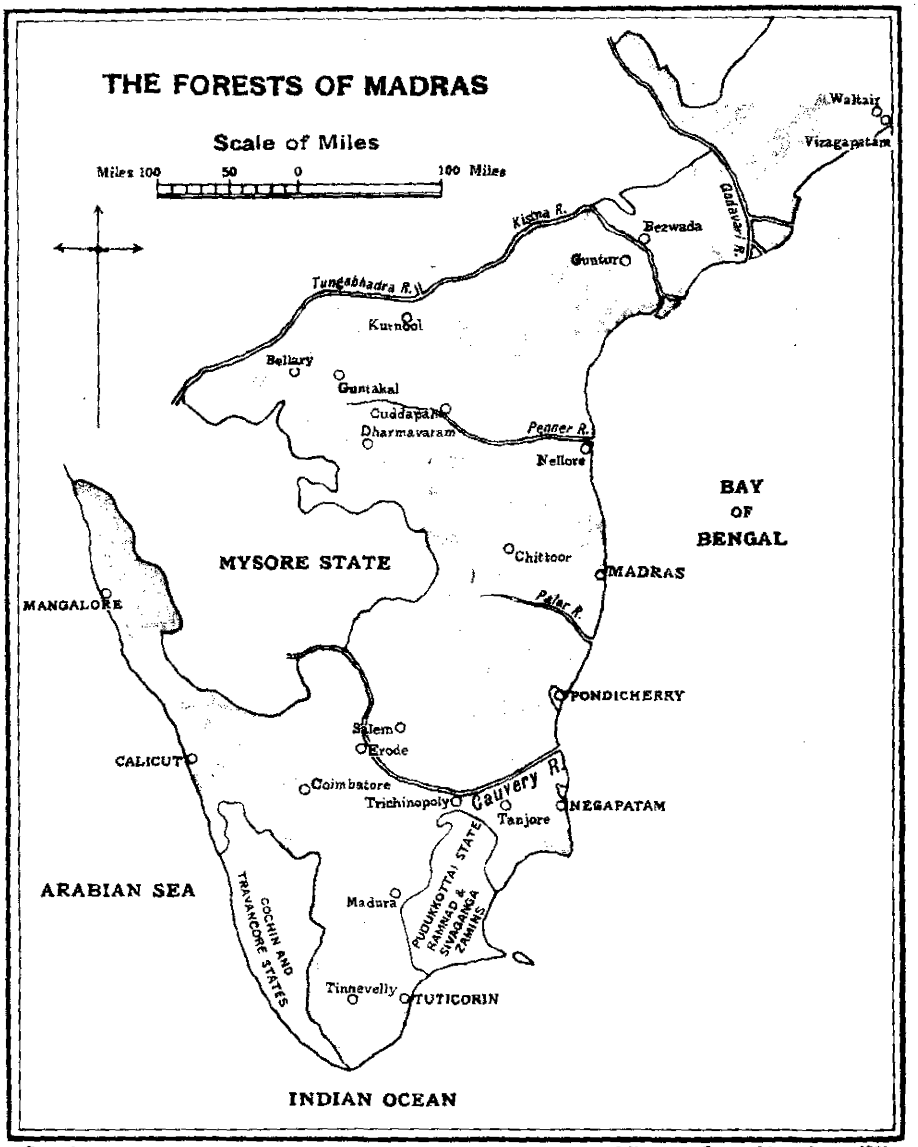
THE MADRAS FORESTS



Photograph by M. V. Laurie.

NILAMBUR: HELPING RAFTS OVER THE SHALLOWS

Price 3 annas



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THE
MADRAS FORESTS

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INTRODUCTION

PROPAGANDA is an ugly word, and the idea of it is distasteful to most of us. Yet in a pamphlet of this kind, which aims at giving in the briefest outline an idea of the activities, aims and problems of forest administration in Madras, it is hard to avoid a flavour of it. If this is there the reader is asked to be indulgent.

The writer wishes to acknowledge his indebtedness to Mr. Ford Robertson whose book on the forests of the United Provinces had much to do with the origin of this pamphlet.

W. G. DYSON.

THE MADRAS FORESTS

Chapter I.—The History of the Madras Forests.

There are people still living in the forests of Madras (as early man lived everywhere) who are as dependent upon the jungle as the beasts of the field themselves. They grow no crops; the forest supplies all their simple wants of food and shelter. With the precarious life they lead their numbers remain small. They can live indefinitely in equilibrium with the forest.

But with the advent of the first primitive form of cultivation an agency of destruction came into being which has brought about a worldwide devastation of forests. This is the practice of shifting cultivation known variously in Madras as podu, kumri, ponam or thakkal. A piece of virgin forest is felled and burnt, and on the rich forest soil, made richer by the burn, the cultivator raises a heavy crop with a minimum of effort. With luck, a second crop follows, less productive than the first. By the time that has been harvested the soil has lost its fertility. Often, indeed, most of the soil itself has been lost, washed away by rain from the exposed hill sides. So a fresh piece of forest is felled and treated in the same way, and every year or two the process is repeated. On the impoverished soil of the abandoned clearings a secondary growth appears, far inferior to the virgin forest; and after a lapse of time, perhaps twenty years, the soil has been restored sufficiently to tempt the cultivator to make a second clearing of the area. This time his crop is poorer and so is the regrowth that appears, for more soil has been exhausted or lost. And so the process goes on until denudation reaches a point at which an attempt at further cultivation is not worth the trouble.

When this stage is reached on all the easily accessible land the cultivator is forced to turn his attention to settled cultivation in the plains and valleys. This means a great social advance. It also means a new burden on the degraded forests left over from the era of shifting cultivation. The shifting cultivator needs few cattle. He does not plough, for surface scratching is all the forest soil needs to give him his crop; and he does not manure his clearing, for he moves on to fresh fields when the fertility of his *podu* patch begins to fail. But in the settled life of villages with permanent cultivation needing cattle for work and manure, as well as for milk and other dairy produce, herds multiply amazingly. Every village

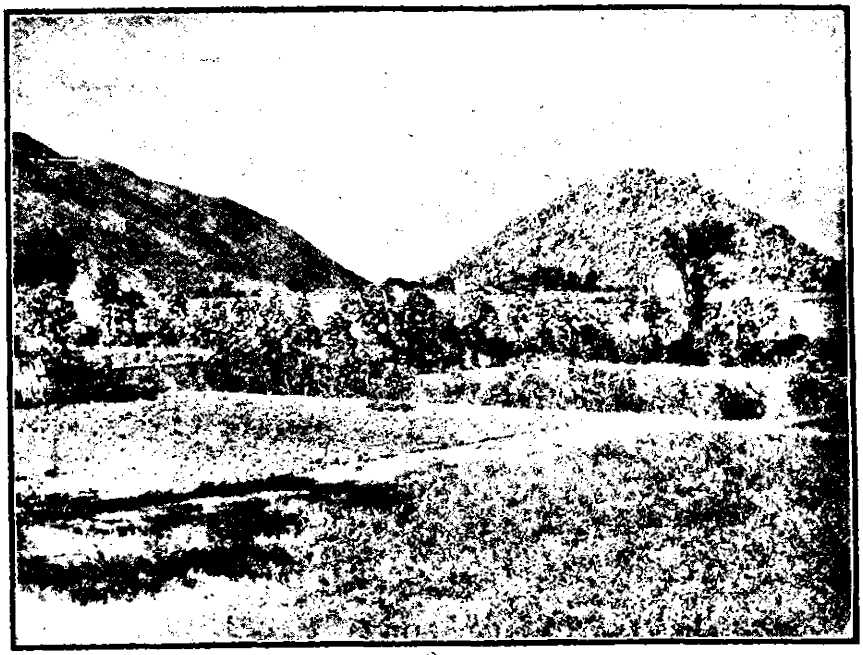
within reach sends its scores or hundreds of promiscuously-bred " scrub " cattle, nearly all useless for anything but the production of manure, to graze daily in the forest.

An overgrazed forest can only degenerate. On level ground the tread of cattle hardens the surface to the semblance of a beaten track on which no seedling can get a footing. On slopes the soil is disturbed, to be washed downhill by rain. Tender seedlings are eaten with the grass, or are sought out deliberately if grass is scarce, so that no young trees grow up to replace the old ones when they die. If goats graze too the situation becomes ten times worse, for they are browsers. Forests and goats *cannot* live together.

Madras can show very good instances of all these stages of forest destruction accompanying the advance of civilization. Little clans of Kadirs, Shola-naickens, Kurumbers and others still live in the heavy forests of the Western Ghats just as they did before agriculture was thought of. Shifting cultivation has been stopped or brought under control in nearly all Government forests, but in the " Agencies," in private forest in Malabar and elsewhere, on the " Badaga lands " of the Nilgiris, and (in a modified form) in South Kanara it still survives, with the usual disastrous results. Over the greater part of the rest of the Presidency these agencies of destruction have obliterated the forest altogether, or have reduced it to a poor scrub.

The long peace of the nineteenth century with its increase in population and the increased demands of a more complex civilization bore heavily on the forests all over India. In Madras local shortages made themselves felt quite early in the century. Difficulties encountered in meeting the demands of the Bombay Dockyards for teak led Mr. Conolly, the Collector of Malabar, to begin the teak plantations of Nilambur in the early forties. This earliest beginning of systematic forest management in India is also one of the most successful. Though teak lost its supreme importance in ship building long before Mr. Conolly's plantations came into bearing, the work has gone from strength to strength, and to-day the Nilambur plantations, still rapidly expanding, are among the most productive and valuable forest properties of their size in the world.

The period of railway construction was another time of heavy inroads upon the forests. By the early sixties serious anxiety regarding the dwindling forest resources in many parts of India caused the Government to undertake a general enquiry which resulted in the modest beginnings of the Indian Forest Service.



Photograph by H. G. Champion.

THE FINAL STAGE.

Complete denudation of the hill on the right which is surrounded by village lands. On the left the hills still carry enough vegetation to preserve the soil from erosion—Vellore Division.

Chapter II.—The Work of the Forest Department.

Forest Settlement.

The Madras Forest Act became law in 1882. From then until the early years of the twentieth century the main preoccupation of the department was the examination, often amounting to exploration, of blocks of forest for reservation, the fixing and demarcation of their boundaries and the settlement of claims.

No one would suggest that a country should be clothed with forest from end to end. *Every* country denuded beyond a certain point has found bitter cause to mourn the loss of its forests. Where then lies the happy mean? Experts have put it at 20 per cent of a country's total area, but the figure must obviously vary vastly with circumstances. For comparison with Madras the forest areas of other provinces are Burma 67 per cent, Assam 38 per cent, the Central Provinces 20 per cent, Bengal 14 per cent, Bombay 12 per cent and the United Provinces 5 per cent.

Those responsible for the Forest Settlement of Madras were able to set apart as reserved forest an area equal to about one-eighth (12 per cent) of the Presidency. There are, of course, other lands under forest, of a sort. There are the ordinary " unreserves " (Government waste lands) fast disappearing under expanding cultivation and degenerating through over-grazing, and privately owned forest land in Malabar and elsewhere. Practically none of the private forests is under any form of management other than a ruthless exploitation of anything worth having. Neither of these classes of land can be regarded as a permanent forest asset to the country, and of the 12 per cent of Madras which has been set apart as a permanent forest estate a large proportion is the poor scrub jungle of the drier districts. It will be conceded that Madras has not, at all events, *too much* land under forest, and that it is an urgent duty of the administration to preserve, protect and improve what it has.

Forest Protection.

A very large part of a forest officer's time is taken up in protecting his forests against the various dangers which threaten their existence. Of these dangers, damage and abuse by man, direct or indirect, is by far the most acute.

Deliberate theft for profit is the least of his troubles. It is the sum total of innumerable petty offences, each trifling in itself, that causes the most serious direct damage—offences such as the pilfering of small timber, fuel and bamboos, and loppings for cattle fodder and green manure.

Indirect damage by man is a still more serious problem. It works through two agencies, fire and grazing. The two are inter-connected, for by far the most common cause of forest fires is the burning of dry grass by graziers to get a flush of fresh green grass early in the season; and it is precisely at this time, when early showers have loosened the exposed and almost bare soil on the burnt areas, that grazing is most harmful.

It is an obvious duty of the Forest Department to the public to arrange for a legitimate means of meeting local needs for forest produce wherever this can be done without violating the principles of forestry. The department is alive to its obligations in this respect and does its best to meet them. Quite apart from the moral obligation, it looks upon the arrangement of localized fellings, where exploitation can be controlled and supervised, and where the regeneration of the forest can be cared for, as the most effective means of protecting the forest as a whole against indiscriminate misuse. In the matter of lopping for leaf manure, and more especially as regards grazing, it is often necessary, for the present, to reach a compromise between the real needs of conservancy and questions of expediency.

Fire protection remains largely an unsolved problem. Limited areas can be, and are, successfully protected by a system of fire-lines and patrols. But in the huge forest blocks of the drier districts, the sea of tall grass and the long intense hot weather combine to make even the broadest fire lines of doubtful efficacy: and even if effective the cost of an adequate net-work of lines would be more than the department can afford. Recognizing the failure in such places of the old-fashioned measures of protection a system of " controlled " or " early " burning was in vogue for some years, and still persists in a modified form in some divisions. Its underlying idea is that a fire set purposely under departmental control early in the season when the grass is just dry enough to burn slowly is, compared with a late accidental or wilfully set conflagration, the lesser evil. This method was given a determined trial over a number of years. It is now out of favour: the practical difficulty of carrying it out in the ideal way is great, perhaps insuperable. In forests of this class there is little doubt that the ultimate solution of the fire problem depends upon the spread of education and the development of a sense of civic responsibility in forest matters.

Other aspects of forest protection are mainly of professional interest and need scarcely be mentioned here. They concern natural dangers such as wind and drought, animal enemies (porcupine, pig, deer, bison and elephants), insect pests and plant diseases.

Forest Management.

The last section tries to give an idea of some of the problems the Forest department encounters in the mere protection of the property entrusted to its care. But the management of a property does not end with its protection : it must be developed, used, and improved.

A fundamental principle of management is that a forest should be worked up to, but not beyond its " possibility " and that in doing so its productivity should in no way be impaired. In other words it should be worked for the maximum *sustained* yield. The capital represented by the standing forest and the soil it grows on, must not be encroached upon either by felling too much, or by felling in such a way as to endanger the soil's fertility. Only the " interest " (the annual increment in growth) is harvested each year. By observation, stock-mapping, enumeration and measurement, and by a consideration and analysis of all the facts available, the maximum permissible cut and the manner in which it can best be made, *without endangering the forest capital*, are determined. The urgent importance of avoiding overfelling and a reckless exposure of the soil is one reason why forest management may sometimes seem conservative and cautious to excess. A mistake in farming is usually not long in making itself evident, and at some expense it can usually be remedied; but in forestry a mistake in management may not become manifest for a generation, and the damage once done is often irreparable.

All these matters are considered and dealt with in the " Working Plan," a scheme governing the activities of a forest area (usually a district) for a ten-year period. The Working Plan discusses and lays down the object of management of the forest as a whole, or of its constituent parts; whether flood-control, timber production, sandalwood, bamboos or grazing should take priority. It lays down the quantities that may be removed, where they may be cut, where and how new crops are to be grown, and where thinning or other tending operations are to be done. It deals with problems of protection, provides for the exercise of rights and privileges, and (as far as it can) for the regulation of grazing. It also makes recommendations on such matters as roads and buildings, staff and the marketing of produce.

On the District Forest Officer, besides the general protection of his forests and administration of his division, falls the duty of giving effect to the provisions of the working plan. He arranges the marking, felling and extraction, and sale of timber, the working of fuel and bamboo coupes, the collection of minor forest produce, the control of grazing, the maintenance of roads and buildings and the construction of new ones. In the

chief timber districts he captures and trains elephants for work, and is responsible for the care and management of a number of working elephants. Not least among his duties is the protection of game.

A forest division usually has four or five ranges, each under a trained non-gazetted officer (Ranger), and each range is divided into a number of forest guards' beats. A beat is usually some ten square miles in extent. Each ranger has one or two, or sometimes several foresters to help him with special works. Foresters and forest guards are untrained men. Rangers are trained at the Madras Forest College at Coimbatore. Divisions are grouped into circles under Conservators. There are special branches under gazetted officers dealing with research, utilization and engineering.

The head of the whole department is the Chief Conservator of Forests at Madras.

Chapter III.—The Forests and the People.

There are two quite separate and distinct aspects of this matter which it is well to bear in mind from the start—first, the relation between the forests and the people as a whole; and second, the forests in relation to the people who live in their immediate neighbourhood.

To the people at large a good, adequate and flourishing forest estate means plentiful, good and cheap timber, fuel and bamboos, and other produce that can bear the cost of transport. If the forests run at a profit it means, in addition, so much money in their pockets as taxpayers. These are the obvious and least essential benefits; the really important ones are indirect.

It is often loosely said that forests increase rainfall. This is not so: or at any rate the effect of forest growth, even over very large areas, on the quantity of precipitation has never been shown to be more than infinitesimal. What forests do is to hold up and regulate the flow off of the rain that does fall. A denuded hillside is a fair approximation to the roof of a house, and storm water shoots off it in much the same way. Instead of a blessing heavy rain becomes a menace, causing destruction and discomfort, danger to life, interruption of communications, silting of fields and tanks, damage to crops and general unpleasantness. With this compare what happens when rain falls on slopes clothed, for example, with the best protective forest, the tropical evergreen rain-forest of the Western Ghats. The heaviest deluge impinges first on the topmost canopy, high above the ground, where the large wind-driven drops are broken up into an all pervading mist or drizzle which trickles down the

Photograph by H. G. Champion.

NEDUNGAYAM BRIDGE, NILAMBUR DIVISION.
Built by Mr. E. Dawson, Forest Engineer, in 1933.

twigs and branches or falls gently from leaf to leaf to reach the ground, where it finds a thick layer of spongy leaf litter to absorb it. Slowly it saturates this, and only then can the surplus water find its way to sub-soil levels to feed the springs and maintain a steady and perennial flow of water in the streams.

These are extreme cases. They illustrate protective forest at its best, and what happens in its absence. Most of our forests fall far below the ideal, but any forest cover is better than none. It is the constant aim of forest management to conserve and improve the cover it finds on the ground.

If examples are wanted, take the valley of the Noyil river in the Coimbatore district, with its catchment of well-clothed hills and compare its prosperous cultivation with the arid conditions in the neighbouring Tadagam Valley whose stream sources have been denuded. Or compare the clear flow, even in spate, of the Nedungayam river near Nilambur, with the silt-laden flood water of any of the neighbouring streams rising in the degraded forests of the adjoining valleys. Consider also the progressive diminution of the area under wet cultivation in such districts as Cuddapah, which is without a doubt due to deterioration through fire of the forest cover in the catchment areas. Instances could be multiplied indefinitely all over the Presidency. Thousands of minor tanks and the hundred of thousands of acres of wet cultivation under them depend on the maintenance of forest cover on the distant upper waters of the streams which feed them.

So much for the people at large. Take now the case of villagers living in close contact with the forest—within, let us say, a distance of five miles from the reserve margin. They share the general benefits that have just been described and enjoy as well a great many direct advantages. They send their herds to graze at a nominal fee; fuel and small timber, bamboos and thorns for fencing are cheap and easy to obtain; grass in head-loads is theirs for the cutting; green leaf manure is often made available to them. Finally there is employment for them in the slack seasons of agricultural work. A large proportion of the expenditure of the forest department is paid in wages to the people of this zone for cutting and carting fuel and timber, clearing and burning lines, sowing, planting and tending, making and mending roads, buildings and wells.

On the other hand it is on the people of these marginal villages, *and on them alone*, that the inconveniences and irritations of forest restrictions fall: restrictions, let it be remembered, that are imposed in the interest of themselves and their posterity.

Photograph by M. V. Laurie.

HIGH-LEVEL PASTURES AND CATCHMENT AREA OF A BHAVANI RIVER AFFLUENT. AVALANCHE-NILGIRIS.

Take for example the grazing question. Not many years ago, the forests were divided into blocks and for grazing in any block a separate permit was needed—an imperfect arrangement, it is true, but one tending to spread the incidence of grazing over the pastures available. Now a single permit costing a few annas a year entitles the holder to graze his cattle throughout the forests of a division. Much has been heard of late about the improvement of cattle-breeds and everyone knows that one of the chief rural problems all over India is the immense number of uneconomic " scrub " cattle to be found wherever there are grazing grounds on which huge herds can be kept for next to nothing. These are the conditions which obtain to-day in the forests of Madras. A fee fixed far below the market value, with no power of limitation of the number of cattle grazed, or of the seasons of grazing, is unquestionably resulting in a serious degradation of many of the marginal forests, and in the perpetuation of the large herds of under-bred uneconomic cattle.

Increasing attention has been given in recent years to the management of suitable forest lands as pasture, but with the present absence of regulation real progress is impossible. The only control the department has is the power of complete closure, where this is a silvicultural necessity; and that this power is sparingly used is shown by the fact that out of 16,000 square miles of reserved forest only an area of 2,000 square miles is closed to grazing. In these 2,000 square miles there are large areas where light grazing would be harmless or even beneficial, and had it the power the department would gladly open such areas to the grazing of limited numbers of cattle at specified seasons. But it dare not throw them open to unrestricted grazing, and to this, at present, the only alternative is complete closure.*

A conference representing the whole of India recently met in Madras to consider the question of forest grazing. The following is an extract from its report :—

> " . . . We desire also to emphasize the point that grazing grounds upon which unlimited numbers of livestock can be maintained at no, or entirely trivial, cost inevitably become a factor encouraging the deterioration of livestock. There can equally be no question that these same grounds, with proper management, should and could be a valuable factor in the improvement

* Since this was written the Government of Madras have agreed to a form of regulated grazing in some of the forests of Kollegal, Coimbatore North and Chittoor.

> of the cattle of India . . . . Control, involving limitation of numbers as may be necessary, over the cattle utilizing the grazing in forest lands is a crucial necessity without which proper management is impossible."

Enough has been said to show that concessions in grazing have gone as far as, and even beyond, the safety point. If grazing grounds are to be saved from further deterioration, and their quality and that of the cattle, ultimately improved, more and not fewer restrictions are inevitable.

As with grazing so with other bones of contention such as lopping for leaf manure. Concession has gone as far as it can : the restrictions that remain are essential. Nobody likes restrictions, but the blessings of forest conservancy cannot be enjoyed without some restraint.

As those directly concerned in imposing this restraint the lower ranks of the forest department come in for a good deal of adverse criticism. They are accused of being oppressive and corrupt. They are probably no better and no worse than the ordinary man of similar status in other walks of life. No one is more anxious to weed out the undesirable than his own superior; but in his attempts to do so he finds his efforts constantly frustrated by an attitude on the part of a section of the public that seems positively calculated to shield corruption. It is notoriously hard to bring home a charge of bribery. The ultimate remedy lies in the hands of the people themselves. The growth of a public opinion looking upon bribery with the contempt it deserves and willing to come into the open to condemn it, would very soon mean the end of it.

From time to time the department finds its policy the subject of criticism. Forest officials are no more immune than other specialists to the danger of taking a narrow view. Informed criticism and the airing of grievances are therefore to be welcomed. Unfortunately the criticisms cannot always be described as well informed. The popular leader who lends his support to an agitation for the relaxation of restrictions without a careful examination of both sides of the question, may earn a little easy local popularity, but runs the risk of doing his supporters and his country a real disservice.

This consideration leads back to the distinction drawn at the beginning of this chapter between the people as a whole, in their relation to the forests, and the people on the forest fringes. It has been shown that while the people as a whole derive direct and indirect benefits from forest

conservancy and suffer no inconvenience from the restrictions which are its corollary, the marginal villagers enjoy the same and added advantages, but on them falls the irksomeness of the restraints. This is a point which is often overlooked when forest grievances are discussed. It is apt to be assumed that *all* village cattle go to the forest for grazing, and that *every* ryot could (but for the restrictions) help himself to leaf manure from the reserves. The facts are these—there are 24 million head of cattle in Madras and of these 1½ million, or about 6 per cent are within reach of forest grazing. Corresponding figures for population have not been worked out but it is safe to say that far less than 10 per cent of the people of Madras live within the forest fringe. The point to be emphasized is that when a concession is made, say a reduction in the fee for grazing, a present is made to a small section of the people at the expense of the rest.

Before leaving this subject mention must be made of a bold step taken in 1924 when some 3,400 square miles of forest of mainly local value were transferred to the control of village panchayats. Some of these have taken their responsibilities seriously, but on the whole misgivings are felt. In its latest review of the management of these forests, the Board of Revenue remarks " Most of the Collectors report that the ordinary revenue staff has not been able to devote the requisite attention to the panchayats with the result that many of them are left to take care of themselves. The forest have in consequence deteriorated to some extent."

Chapter IV.—Products of the Madras Forests.

Timber.

The chief timber bearing forests are along the Western Ghats. They are of two types—evergreen and deciduous.

The function of the evergreen forests is mainly protective. They clothe the almost precipitous slopes of the hills in a rainfall zone of 200 to 300 inches a year, regulating the flow of water in all the West Coast streams and protecting the upper waters of many of the rivers flowing eastwards to irrigate wet lands in the dry districts. They must, therefore, be worked with the utmost caution to keep unimpaired their protective value. This is done by a system of very careful selection fellings with strict safeguards. The principal outturn is sleepers of *Mesua ferrea* and *Hopea parviflora*, sawn in the forest and supplied under a contract direct to the railways.

The protective value of the deciduous forests, though great, is not so vital as that of the evergreens, for they occur generally in more level country and in regions of less torrential rainfall. Partly for this reason and partly because their silvicultural management is better understood, a more intensive exploitation is permissible. The system in vogue is one of clear-felling suitable areas and replanting them, mainly with teak. The areas unsuitable for conversion into plantations are worked under conservative selection fellings. It is from these forests lying mainly in Malabar (Wynaad and Nilambur), in South Coimbatore (Anamalais) and in the Godavari district that the bulk of our timber comes.

The felled logs are usually dragged by the department's elephants to roadside or riverside depots, whence they are carted or floated to the main centres of consumption or distribution—Beypore, Pollachi, Mysore and Rajahmundry.

Teak is the outstanding timber of forests of this class. In value but not in quantity rosewood is nearly its equal. Vengai (*Pterocarpus marsupium*), Venteak (*Lagerstroemia lanceolata*), Karumarudu (*Terminalia tomentosa*), Pillamarudu (*Terminalia paniculata*) and Irul (*Xylia xylocarpa*) are the chief among the other trees which are marketable. There are other timbers, excellent in themselves, but at present " unfashionable." It can only be a question of time before many of these come into favour.

The potential value of this class of forest is being greatly increased under the present system of conversion. Mention has already been made of the deservedly famous Conolly teak plantations at Nilambur, now well into their second rotation. Similar series of plantations are being built up in many other parts of the Presidency; wherever, in fact, conditions are suitable. At Mount Stuart in the Anamalais, and in the Wynaad large areas have already been converted to pure teak. In all, the area under planted teak is being increased by about a thousand acres every year.

Sandalwood.

Sandalwood grows almost anywhere, even at sea level and in regions of heavy rainfall. But its typical home is in the dry forests bordering on Mysore at elevations between 2,000 and 3,500 feet. It is a root parasite—that is to say it can thrive only by attaching itself to the roots of another tree from which it extracts nourishment. In many places it is severely attacked by an insect-borne " virus " disease known, from a curious deformity it causes in the foliage, as " spike disease." Spike disease is incurable and always fatal. Its ravages have been so severe

since it made its first appearance at the beginning of this century that working is almost confined to the removal of dead trees. Fortunately sandal regenerates itself so freely that, in spite of the loss from spike there is little cause for anxiety about future supplies.

Sandalwood is so valuable that its extraction is governed by a most elaborate set of rules and accounts, and there are strict " transit rules " to regulate its transport from place to place. Every bit of the tree containing heartwood is marketed—roots, chips and even saw dust.

North Salem, North Coimbatore and West Vellore produce the bulk of the Presidency's outturn of sandal. After elaborate cleaning and grading the final product is sold in the depots at Satyamangalam and Tiruppattur, chiefly to Bombay merchants for export to Germany and America.

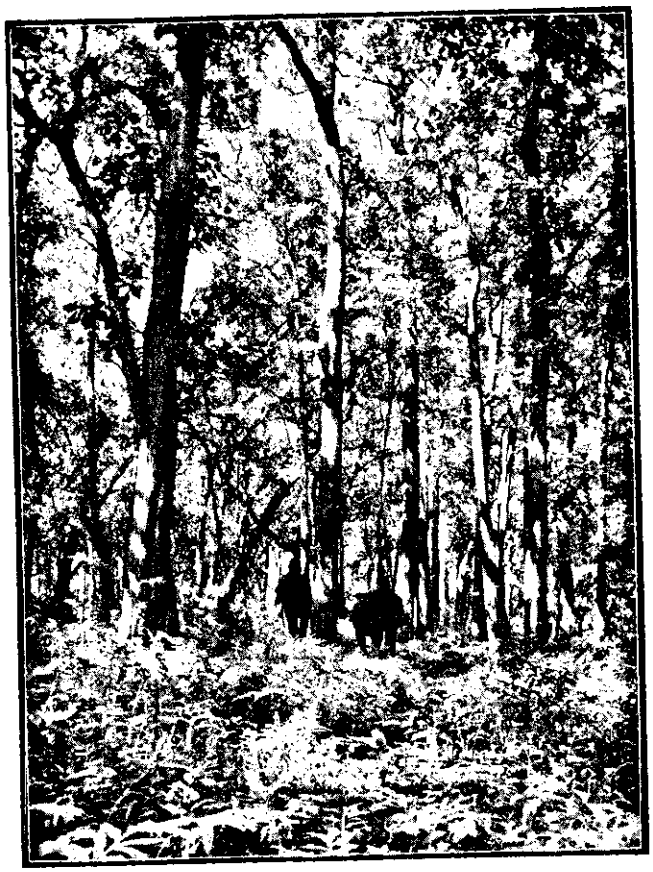
Fuel and Small Timber.

Nearly all forests bordering village cultivation of the plains are worked for fuel and small timber, the system being to lease " coupes " in rotation. The coupes are usually clear-felled, and for replacing the felled growth coppice regrowth from the cut stools is mainly relied upon. But of late much attention has been paid to supplementing this coppice regrowth by sowings.

Most of the big towns—Madura, Coimbatore and Rajahmundry, for example—depend very largely on forest reserves for their fuel. Madras draws large supplies from the forests of Chittoor and Cuddapah and from the Island of Sriharikota. The thriving casuarina plantations along the coast are now nearly all in private hands, an enterprise which one would like to see copied elsewhere. Ootacamund and Coonoor owe their cheap supplies of good firewood to the splendid Eucalyptus plantations started by the pioneers of forestry in Madras to save the native sholas from destruction.

Bamboos.

Almost every forest division has its bamboo coupes. They are leased to contractors with safeguards designed to prevent over-exploitation of the more easily accessible areas. Generally speaking supply is far in excess of demand. The growing likelihood of the successful establishment of paper mills using bamboo as their chief raw material encourages the hope that before long our bamboo resources will be used more fully than they are at present.



Photograph by M. V. Laurie.

NATURAL TEAK FOREST.
Mt. Stuart Forests, South Coimbatore Division.

Minor Forest Produce.

This includes all kinds of things : barks and fruits for tanning ; grass, fibres and leaves (including leaves for beedi-making) ; canes ; edible and medicinal plants ; honey, wax and horns ; gums and resins and many others.

The right to collect them is almost always leased.

Recently the department has given much attention to a new activity—the cultivation of lac. The lac of commerce is refined from the gummy incrustation exuded by an insect which lives by sucking the sap of trees. Trees of the proper kind are first lopped to promote the growth of suitable sappy shoots. When these reach the right size they are " inoculated " with lac insects of the correct strain for the kind of tree in question, and in due course the incrustation is formed and harvested. The department has a flourishing lac centre in the Madura district, a smaller one at Denkanikota in North Salem and many experimental centres elsewhere.

Revenue from the different products.

Timber contributes 30 per cent to the total forest revenue, fuel 14 per cent, sandalwood, grazing and minor produce each about 12 per cent, bamboos 9 per cent and miscellaneous items make up the remaining 11 per cent.

Chapter V.—Financial Results.

For the past three years the Madras Forest Department has shown an average annual surplus of 5-1/3 lakhs on a total average annual expenditure of about 40 lakhs. In this connection the following considerations should be given due weight :—

(1) With sound management for *sustained* yield forestry is a safe investment from which sensational returns *in cash* are not to be expected. Nothing would be easier than for an irresponsible administration to show large surpluses *for a time.*

(2) Madras is less fortunate, from the financial point of view, than some Indian provinces, in that a high proportion of its forest, though essential for meeting local demands and for conserving water-supplies, is not (and is never likely to be) *directly* remunerative. And it is precisely this type of forest which is the most difficult and expensive to protect.

(3) Political considerations have led to the fixing of grazing fees at a point far below the market value of the facilities offered, and reluctance to admit regulation of grazing prevents the management of pasture lands to the best advantage. Run on purely commercial lines the revenue from grazing could easily be trebled.

(4) The department receives no credit for the value of produce given away as concessions and free grants—for example, free grazing; and timber and bamboos to rebuild burnt villages. The revenue foregone in this way is rather more than a lakh of rupees each year.

(5) The department's balance sheet leaves quite out of account the incalculable indirect benefits which the forests confer. The control of floods and the conservation of water, on which huge areas of wet cultivation (and the lives of countless people) depend, have no place in it. Not an anna is credited for preserving the streams feeding the Pykara Hydro-Electric Project with all its ramifications and its crores of invested capital.

Clearly, this property of the public should be managed to produce the greatest profit that it can, legitimately. But it is easy to attach undue importance to actual cash returns. The people of Madras possess a forest estate which it is an obvious duty of the State to preserve and develop, and which in time, with careful and conservative management, may become nearly equal to their needs. It pays its way and makes a modest contribution to the general revenues of the Province, and as past and future work begin to bear fruit this contribution will steadily increase.

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Bulletin No. 159

UNION OF SOUTH AFRICA

DEPARTMENT OF AGRICULTURE AND FORESTRY
(Division of Forest Management)

(FORESTRY SERIES No. 3)

Forests in Relation to Climate, Water Conservation and Erosion

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PREFACE.

THE subjects of erosion, soil deterioration and the effect of afforestation on water conservation have been prominently before the public during the past year or two and, when opening the Fourth British Empire Forestry Conference at Durban in September, 1935, the Hon. the Minister of Agriculture and Forestry took advantage of the fact that prominent foresters from all parts of the British Commonwealth of Nations were about to sit in Conference in the Union, to request them to go into these matters.

A special Committee was appointed to inquire carefully into and report on the subject of " Forests in relation to Climate, Water Conservation and Erosion ", and the members of that Committee paid particular attention to these problems during the course of a six weeks' tour in which they inspected eucalypt plantations on the Zululand coast, wattle plantations in Natal, and forests and plantations in the Eastern Transvaal near Sabie, in the Northern Transvaal near Duivelskloof, and in the Divisions of George, Knysna, Caledon, and the Cape. The subject was, in addition discussed at plenary sessions of the Conference and it was agreed that the Government of the Union of South Africa should be requested to publish the Report of the Committee and some of the annexures to that report as a pamphlet.

This bulletin is the outcome of that request. It comprises the report of the Committee referred to above as approved by the Conference, the verbatim report of the debate on the subjects concerned, and two memoranda submitted to the Conference by Mr. A. D. Lewis, Director of Irrigation, as he was unable to attend the debate and put forward his views verbally.

I am sure that it will prove of great value to those personally concerned with the problems of prevention of soil erosion and conservation of our water supplies, and of interest to the public generally.

P. R. VILJOEN,
Secretary for Agriculture and Forestry.

5th November, 1935.

EMPIRE FORESTRY CONFERENCE, SOUTH AFRICA, 1935.

REPORT OF THE COMMITTEE ON FORESTS IN RELATION TO CLIMATE, WATER CONSERVATION AND EROSION.

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NOTE.—Annexures II, III and VI are not included in this bulletin. Annexure VI will later be amplified and published.

INTRODUCTION.

The Committee was appointed at the special request of the Minister for Agriculture and Forestry and was directed to inquire into the whole question of forest influences, i.e. the effect of forests on climate, water conservation, and erosion, with special reference to South Africa, and the establishment in that country of forests of exotic species.

Obviously a general Conference of this nature, following a rigid itinerary and arranged to permit a survey of the whole field of forestry activities in a period of between five and six weeks only, could not offer sufficient time or adequate travelling facilities for an exhaustive investigation of the highly important subject of forest influences. However, the Committee itself and the Conference as a whole embrace members who for many years have had the subject under constant review, and who are therefore competent to treat the matter with some degree of authority. Secondly, we have had at our disposal a wealth of literature dealing with the subject, not only in countries comprising the British Empire, but also in other countries which from time to time have been faced with acute conditions of the same problem. Thirdly, anticipating that the subject was one to which special attention would be given by the Conference, some of the forest authorities who are participating in the Conference presented specific statements treating the subject in great detail. Fourthly, the subject was fully debated at plenary sessions of the Conference, and we would point out that the members of the Conference represent almost every part of the British Empire, every climate and major type of vegetation which occurs in nature, from arctic to tropical, from northern coniferous forest to mangrove swamp or thorn forest. Fifthly, we have had the advantage of lengthy interviews with laymen and experts who have given the subject a great deal of consideration and investigation; in this category are the several engineers, botanists, agricultural officers, wattle growers and farmers who have appeared before the Committee. These included Mr. van Reenen, Chairman of the Irrigation Commission, Mr. Lewis, Director of Irrigation,* Mr. W. R. Thompson, University of Pretoria, and Professor Phillips of the Witwatersrand University, who, in addition to presenting his views verbally to the Committee, handed in a memorandum containing useful information on the subject.

It is upon these grounds that we submit a report in which we have endeavoured to treat the subject in a non-partisan spirit and with a due sense of the complexity of the problems involved.

In view of the value of much of the information presented to the Conference, we attach to this Report, for the consideration of the Government of the Union of South Africa, Annexure I, the verbatim report of the debate on the subject, and we would particularly refer to the summing up of the debate by the Chairman of the Committee. We also submit Annexures II to VI, which deal with various investigations which have been made in different parts of the world, furnish concrete evidence of the evils of forest destruction, deal with experiments on veld-burning, and include memoranda submitted by Mr. A. D. Lewis, Director of Irrigation.

We desire to emphasise the fact that the subject is of vital importance, not only to South Africa, but to all other countries of the Empire, indeed to the world at large.

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* Mr. Lewis placed his views before the Committee in writing as he was unable to appear before it.

I. FORESTS AND CLIMATE.

(a) *Preliminary Remarks.*

The influence which forests have upon climate has been the subject of investigation for a great many years. Also, it has on numerous occasions been the cause of heated and at times quite unreasoned controversy. As so often happens when there are inadequate scientific data for the settlement of a technical problem, people divide themselves into opposite camps taking extreme views and giving vent to dogmatic assertions which cannot be justified by the facts available. The reaction of such extremist statements upon the public mind is most unfortunate, and often in the heat of controversy the main issues become obscured.

In a field where there is still so much to be learned and so many scientific facts to be established, it is hardly to be expected that we can in the short time at our disposal, set forth completely and finally the effects of forests upon climate. In the ensuing pages, however, building upon the information at our disposal, we have made an effort to present the facts as they appear to us.

In dealing generally with the question of forests and climate (and the same applies in regard to the influence of forests in other directions), we wish to emphasise the fact that under the term " forests " we do not include mere patches of exotic plantations or small isolated areas of indigenous wood. Rather, we define as forests the more extensive areas of tree-covered land, whether of natural forests such as the indigenous woods of the Knysna region, or of large blocks of plantations, as in the afforested districts of the Eastern Transvaal.

With these preliminary remarks, we will now deal with the relations between forests and climate and in doing so, the effects of forests upon the several factors of climate will be considered.

(b) *Temperature.*

The physiological and physical processes attendant upon plant growth reduce the temperature of the air; firstly, because plants transpire water, and secondly, because the sun's heat is absorbed in the process of evaporation. By reason of its composition the living plant substance cannot become heated to the same extent as bare rock or soil. Moreover, the ground under plants cannot become greatly heated by the sun's rays owing to the interception of the latter by the canopy of vegetation. It follows that the effect of forests during the growing season is to lower the temperature of the air in and above them and, by reducing the absorption of heat by the earth's surface, to lower the soil temperature and correspondingly reduce evaporation. Observations have also shown that forests not only moderate the extremes of heat in summer, but that as a general rule they also modify the extremes of cold in winter. Keeping in mind the fact that it is at the maximum and minimum extremes of temperature that the more serious damage from heat and cold occurs it is patent that, apart from any benefits which may accrue from forests in other directions, their effects upon the temperature of a region are highly beneficial to man and beast.

(*c*) *Wind.*

By diminishing the velocity of winds forests decrease evaporation and wind erosion. Except in so far as very extensive forests may enrich with moisture the air-currents which pass over and through them, it cannot be said that they exert any great or general effect upon the broad continental air-currents.

Locally, however, forests do exercise a very beneficial effect in ameliorating the severity of winds by virtue of the mechanical obstruction they offer, and the uses made of forests, and even of mere patches of woodlands or shelter belts, for the protection of buildings and lands are universally known.

It is therefore unnecessary to do more than state the fact that the influence of forests in modifying the adverse effect of winds is wholly beneficial.

(*d*) *Rainfall.*

After careful review of the data available, we are of opinion that at various times and in different countries, altogether too much credence has been placed in the supposed influence of forests in increasing the total rainfall of a country. We can find no reliable evidence to this effect and would point out that the topographical features of a country exercise a far greater influence upon precipitation than can be exerted by forests alone, however vast. On the other hand, there is evidence to show that forests have some influence upon the local distribution of rainfall, by lowering the temperature of moisture-laden winds, and in other ways, and we affirm that from this view-point a judicious distribution of forests throughout a country is highly beneficial.

(*e*) *Atmospheric Humidity.*

Under a leafy canopy, the humidity of the air is higher in the forest than in the open. The process of transpiration of itself increases the moisture content of the air within and near the forest; also the temperature of the air within the forest is lower, and consequently nearer the saturation point. Under the influence of these two factors, manifestly the influence of forests is to increase relative humidity.

(*f*) *Evaporation.*

Experiments extending over a great many years have demonstrated that the evaporation from soils within the forest is less than in the open. The greater the wind, the higher the temperature, and the lower the relative humidity, the greater must be the evaporation from the soil; consequently, the forest, by reducing the velocity of winds at the surface, by reducing the temperature, and by increasing relative humidity, necessarily retards evaporation.

Experiments have also shown that the evaporation from free water surfaces is less within the forest than in the open. The same factors which operate to reduce evaporation from forest soils also operate to retard evaporation from free water surfaces within the forest.

Within the forest, the extent of evaporation from the soil varies with the character of the vegetation and particularly with the nature of the ground litter. Some trees intercept the sun's rays much more

effectively than others; some species form a litter that retards evaporation more effectively than do others. Whatever the degree of effectiveness of various tree species in this direction, however, all forests tend to retard evaporation from the surface layers of the soil.

(*g*) *General.*

Climate, being a combination of all the above factors, has without doubt seriously deteriorated over large portions of the earth by reason of the destruction of the forest. While afforestation may have only slight bearing on the climatic conditions of a country, the progressive destruction and degradation of vast areas of natural forest result in increasing aridity, the desiccation of the soil and the impoverishment of mankind. We wish to draw attention to Mr. Ainslie's memorandum, Annexure II, which summarises the views of the greatest authorities on West Africa, and especially to the statement of Migeod that the Gaboon is becoming the graveyard of the dying races of Central Africa, dying because of the degradation of the land they inhabit. Mr. Trevor also has drawn attention to the decay of the Asiatic Empires and to the poverty of peoples who inhabit what were once the fairest portions of the earth.

We have tried to make it clear that the climate in general of a continent or broad region is something which is determined very largely by extraneous factors. It has often been either stated or implied that the absolute climatic factors, temperature, wind, and rainfall, are the result of solar and terrestial conditions which man cannot alter. We have pointed to the fact, however, that by exercising judicious control of the vegetative cover, man can modify the effect of absolute climatic factors and so lessen appreciably the detrimental results to which those factors may give rise.

We have no positive proof that during the present era South Africa was to a large extent forested. We do know, however, that within historic times there was a much greater area of natural forest than now exists; we know also that the condition of such forest was far better than it is at the present day. Even assuming that 500 years ago the area now comprising the Union of South Africa was not forested to the same extent as other lands, we do know that the development of the country since the ingress of the white man has been attended by serious depletion of the indigenous forest.

Manifestly we are not in a position to prove that this disturbance of natural conditions has had any appreciable effect upon climatic factors in the absolute sense, we may even doubt that it has. But we do believe, and we shall later seek to establish, that the disturbance of natural conditions has had disastrous effects in other directions.

Such being the case, and taking into consideration the beneficial effects which forests have in ameliorating the untoward results of climatic factors, we cannot do otherwise than commend any and all efforts which are being made, or which can be made, to bring under forest cover a greater proportion of the land area of the Union. Whether or not such extension of forests should be by increase in the area of exotic plantations or by the extension of the area occupied by indigenous species, is for the moment beside the question.

II. FOREST AND WATER CONSERVATION.

(*a*) *Preliminary Remarks.*

Apart from their utility in the supplying of wood products, some of the most beneficial effects of forests lie in their influence in conserving the supply of water for natural springs and reservoirs, and in regulating the flow of streams and rivers. In very few parts of the world is there a reasonably uniform distribution of rainfall. Practically all countries experience definite seasons when precipitation is heavier than at other times. Water being one of the things most vital to animal and vegetable life, the effort of man from time immemorial has been to conserve it and put it to use in such places and at such times as his cultural and industrial pursuits have demanded. It is a sad commentary upon man's efforts in this direction that the earlier civilizations started their conservation works at the wrong end. One of the reasons for the decay of the great irrigation works of Mesopotamia, the ruins of which far surpass any similar undertakings of to-day, was the neglect or inability to control the catchment areas of the Tigris and Euphrates. The control of water supplies must follow natural laws, and it is only in comparatively recent times that this fundamental fact has been realised; even now the attention given to the conservation of catchment areas is wholly inadequate.

In life as we know it to-day, one of the main activities of man is to arrest the flow of waters and put them to the greatest possible use before they descend to the seas—for the watering of farm lands by irrigation or otherwise, for the development of hydro-electric power, for the needs of urban and rural communities, for the purpose of navigation, and for similar objects.

It has been held that engineering works constitute the proper means for the regulation of water supply. This is true only to a certain extent. Engineering works cannot take the place of nature; rather, they should be used to supplement and augment her provisions.

It is easily demonstrable that forests play a highly important rôle in the conservation of water and regulation of its flow. Almost every forester can recall a woodland spring that upon removal or serious disturbance of the forest was dried up, and the majority of people can cite instances of the partial or total drying up of water courses, resulting from the same cause.

(*b*) *Run-off.*

It is impossible to divorce water conservation from climate. The first influence of the destruction of the forests is on the moisture content of the land, the diminution of perennial streams, the increase of floods, the deposit of detritus by wind or water, and the gradual reduction of cultivation. All this is followed by increasing aridity, by the greater desiccating effect of wind, by increasing severity of climate, until the land will no longer support a wealthy and prosperous population. Poverty grows with the deterioration of the land until the time arrives when man departs leaving a desert behind him.

Proceeding now to consider in detail the actual effect of forest on various aspects of water conservation.

Mr. A. D. Lewis, in his memorandum, Annexure V, divides the uses to which water is put as follows:—

(1) Navigation;
(2) water power;
(3) industrial and municipal uses;
(4) watering of stock;
(5) irrigation;

to which we would add agricultural and forest crop production.

As regards *navigation*, while this matter is of no consequence in South Africa, Mr. Galbraith in his speech gave a specific instance where the destruction of forest in Australia had resulted in rendering a river unfit for navigation. Many Indian rivers previously navigable by ocean-going sailing ships can now only be navigated by canoes or similar craft. This deterioration is due to the silting of their channels by eroded material from the hills.

Water power may not be of much consequence in South Africa but in other parts of the world is of great importance. We have been told of cases where a somewhat precarious water supply was increased by the afforestation of the catchment area of the stream and the figures obtained from experiments conducted in the Appalachian Mountains and the White Mountains, U.S.A., at Emmenthal, Switzerland, and in the Cevennes, France, prove the more equable flow of water from a forested than from a disforested area.

As regards *industrial and municipal uses*, Mr. Lewis considers these requirements insignificant when compared with the total water resources of South Africa.

We may observe that the experience of all other countries is that catchment areas for such uses are best maintained under forest, and we would recommend here that all important catchment areas throughout the Empire should be placed under sound forest management.

Mr. Lewis proceeds to deal with water required for *irrigation and for watering stock*, and shows that over large areas of 40 in. rainfall country extending along the South and East Coasts, the Drakensberg in Natal and Transvaal, and parts of the Zoutpansberg, afforestation, even if it did decrease run-off, would have no injurious effect on any interests and would utilise some of the surplus water which otherwise would flow to the ocean. In the case of reservoirs and dams the influence of a forest cover in the catchment areas would be beneficial by decreasing run-off and preventing silting; these benefits would outweigh any possible adverse effect on the controllable water supplies. In particular the mechanical obstruction of several layers of foliage, by breaking the force of the very heavy storms which often occur at the beginning of the rains, plays a very great part in reducing the rate of flow and so reducing the silt-carrying capacity of the water.

This question of silting has been causing the greatest anxiety to engineers; the rapidity of silting on denuded catchment areas has often exceeded the professional estimates and has rendered many of these undertakings entirely unprofitable. Irrigation engineers in India are apprehensive on account of the decreasing winter supplies of water and of the increasing number and severity of floods. It has also been proved that silt-laden water does not penetrate into the soil

and therefore largely runs to waste. There is overwhelming evidence that forests have a regulating effect on stream flow, decreasing floods and increasing the flow of water at dry times of the year when streams from a disforested area dry up altogether.

(c) Springs and Natural Reservoirs.

In the last section the effect of forests on run-off and stream flow were considered. We shall deal here with the effect of forests on springs and underground water.

It is often stated that the natural forest, or even the natural veld, are better conservers of moisture than plantations of exotics. Even if this were so, it may be pointed out that, for practical purposes, land under plantations should not be compared with natural veld because the activities of mankind seldom permit of the veld being maintained in that ideal condition.

Mr. Carlson in dealing with this subject remarked that perhaps the fact had been overlooked that the natural forest was composed of a variety of species producing a highly absorbent soil; he advocated mixed crops of trees both for the better moisture conservation of the soil and for the production of timber of better quality. There is every reason to suppose that in the next rotation in South Africa many of the plantations will be regenerated naturally, will contain a greater mixture of trees, including indigenous species, which are already making their appearance in the plantations, and will so approach more nearly the character of natural forest. The Forest Department of South Africa is equally alive to this matter and has no desire to convert natural forest into plantation, but is making every endeavour to preserve and improve all areas of natural forest under their jurisdiction.

In general it may be accepted that forests use up a certain amount of soil moisture and, in areas of low rainfall, may exercise a draining influence on the soil. Some eucalypts have a pronounced action in this respect and have been used for the draining of swamps. We have no reliable information as to how deep this action goes, but we consider it unlikely that it goes much below the depth to which the mass of the feeding roots penetrate, that is, to a few feet at most. We can find no reliable evidence to show that the subsoil water level is lowered by planting trees or that they have any effect on deep-seated springs or on the water table; their action appears to be confined to water on or near the surface, much of which would in any case run to waste on a denuded catchment area. South Africa, as may be seen from a recent publication on the subject*, is at present passing through a series of years of diminished rainfall, and this must have far greater influence on water supply than tree planting.

Researches by Burger and others show that forests allow rain to penetrate into the soil, thereby feeding deep-seated springs. This penetration is due to the fact that forest soil, mainly owing to the action of tree roots which ramify through it, is far more porous than soil of identical origin in the open. The presence of a layer of spongy humus or a mass of needles and undecomposed vegetable matter also contributes to the absorption of water and the prevention of run-off,

* "A Study of South African Rainfall", by Messrs. Schumann and Thompson.

but it is now recognised that the absorptive capacity of humus is of less importance than that of the forest soil itself.

The draining effect of forest is most pronounced on level ground where swamps tend to form. On hillsides any action which may be considered deleterious to water conservation is far more than counterbalanced by the beneficial action of forests in mechanically obstructing the run-off and increasing the porosity of the soil.

In the course of our visits to some of the afforested areas in South Africa, we have received complaints from representatives of the farming community to the effect that the planting up of catchment areas with fast-growing eucalypts and pines had diminished the water supply, sometimes to the extent of causing a cessation of flow in streams which were once perennial. Emphasis was laid in particular on the danger of planting such trees in the neighbourhood of streams, which are alleged to dry up as a result. We would point out in the first place that this is at variance with the generally accepted conclusions regarding the effect of forests on streamflow, and secondly we have the assurance that in many areas where no afforestation has taken place a similar diminution in streamflow has occurred in recent years. Furthermore in Australia, under climatic conditions very similar to those of South Africa, the policy of water conservation boards is to protect strictly the Eucalypt forest on their catchment areas.

All things considered, we are not disposed to place much credence in the complaints instanced above, but we suggest that a comprehensive scientific investigation on the effects of tree-planting upon local water supplies would be of value not only to South Africa, but also to other parts of the Empire. Such an investigation, however, is likely to take many years before yielding definite results. In the meantime we suggest that where the question of water conservation is a vital matter, it would be advisable, in order to allay public anxiety, not to plant fast-growing exotics at the actual sources of streams and the eyes of springs; in such places the natural vegetation should be carefully protected. We understand that the Forest Department is already acting on these lines.

In conclusion, we wish to state that, having carefully weighed all the considerations and evidence available, we do not consider that the afforestation policy of the Government of the Union has been detrimental to the general water supply of the country.

III. EROSION.

It is unnecessary for us to recapitulate all that has been stated on this aspect of the subject during the debate. It is admitted by all authorities on erosion that one of the greatest calamities which have overtaken mankind has been the destruction of the forest and the consequent erosion of the land surface. This has already destroyed the fertility of many lands and is at the present day exercising a powerful influence on the destiny of the peoples.

Erosion results from the misuse of the surface covering of the earth, whether it be by the destruction of the forest which covered it, by the misuse of arable or pasture land, by bad methods of cultivation, by burning or by overgrazing. We are chiefly concerned here with the influence of the forest. Erosion caused by faulty methods of

cultivation or pasture management we leave to the sister science of agriculture; indeed the Drought Commission has pointed out that faulty pasture management in South Africa is at the present day the greatest factor in causing erosion. Nevertheless in dealing with the erosion problem the planting of trees can be as beneficial in South Africa as in other countries confronted with the same problem. Erosion is worse in countries of low rainfall and hot summers than where an ample rainfall covers immediately any bare surface with vegetation. The conflagrations which rage throughout the savannah forests of Africa gradually end in their destruction. The heat of the sun, hot winds and the trampling of stock pulverise the surface soil, which is then blown away by the wind or washed away by the torrential downpours which generally follow prolonged periods of drought. In this way the whole top soil may gradually be eroded away in the form of sheet-erosion, leaving an unfertile sub-soil from which man can at the best eke out a miserable existence. Thus the destruction of the savannah forest leads imperceptibly to the desert which can support neither man nor beast.

The geological formation exercises a powerful influence on the rapidity of erosion. Once denuded of their natural covering, land such as the tertiary formations of the outer Himalaya and the red earths of Africa are eroded with appalling rapidity; likewise the loess plains of the prairie provinces of North America are rapidly ruined by sheet erosion and gullying; so much so that large areas of cultivated land have been abandoned as impossible of repair, and the sky for many hundreds of miles in North America has been darkened by clouds of top soil being blown from farms of the prairie region. The illustrations in the papers submitted to the Conference and to be found in any work dealing with this subject will show how a land surface is utterly destroyed by gullying caused by the rush of water on a denuded soil. There is evidence, however, from all over the world that even where erosion, especially sheet erosion, has actually commenced, it is possible to remedy the position by preserving the natural vegetation and by afforestation.

Where extensive gullying is already present, afforestation must be combined with engineering operations of a minor nature such as the construction of small dams, fascines, etc. The combination of such engineering operations with the protection of the soil from burning and grazing, together with afforestation, can deal with the problem.

Statements have been made in South Africa that wattles and eucalypts promote erosion. This is entirely contrary to fact so far as the Government and large private plantations under proper management are concerned. All these plantations are covered with a thick layer of vegetable detritus, and, in the case of wattles the piling of the brushwood in contour lines subsequent to clear felling entirely prevents soil erosion. The accompanying photographs, Annexure VI, illustrate the method and effects of brush piling. Nowhere have we seen the least indication of erosion in these plantations, nor is the ground bare of cover except on firelines which are rightly swept clean of all such material as a precaution against fire.

We must repeat that too often the erosion problem is considered from the wrong end, and large engineering works are conceived for the mitigation of this evil, whereas the problem should be tackled at

its source in the hills, and cured by the generally inexpensive measures of nature rather than by the costly constructions of mankind.

Enough, we consider, has been said during the discussion of this subject to point out the beneficial effect of the forset as a natural cover of the surface of the earth and of the disastrous results of the destruction of such cover. Whether it be on the mountains of the Himilayas, the highlands of Australia, the savannah forest of Africa or the plains of North America, wind and water, unrestrained, exercise their powers of disintegration on the denuded surface of the earth, ruining land laboriously prepared for the satisfaction of the needs of mankind and rendering once fertile areas sterile and uninhabitable.

IV. Veld Burning.

Although we have been asked to give our views on this subject, as foresters we are more immediately concerned with the forest than with the field. However, this problem of veld burning cannot be considered as entirely one of agricultural importance. The vast fires which rage over the greater part of Africa have resulted in an ecological retrogression from forest, savannah, and scrub to grass ending on the southern edges of the Sahara in the extension of the desert. Thus fire, along with excessive grazing and forest destruction, is one of the most important factors aggravating the desiccation of Africa.

The practice of burning has existed in Africa from before the days of Vasco da Gama and all legislative measures have failed to prevent it. Fire has an unfavourable effect on the moisture content of the country and from this point of view all grassburning may be considered detrimental; but after a few years of complete protection the amount of inflammable material would so increase that an appalling conflagration would sooner or later become inevitable. From the practical point of view controlled burning may be more effective than complete fire protection. We agree with the views of Mr. van Reenen, member of the Drought Commission, that the special circumstances of every case must guide the time and the degree of burning necessary to remove the surplus grass resulting from a summer rainfall. Burning tends to convert forest into grass land and in some countries is definitely used for this end. The protection of savannah forest or even its controlled burning will assist in the progression towards high forest. Where grass land is the climax type, however, excessive burning can do nothing but harm and will result in a deteriorated and weedy pasture hastening the onset of erosion. Each type of veld, depending on climate, altitude, soil and type of vegetation, must therefore be dealt with on its merits and the degree of burning necessary to remove the surplus dry vegetable matter determined. This surplus vegetation must be removed in order to allow the new grass room to develop; mowing is generally impracticable and fire is the only alternative. All the existing evidence, however, points to the fact that this burning should be carried out with great caution, that it should only be done when absolutely necessary, and that it should not take place when weather conditions are such that the blackened surface of the ground will be left for months uncovered at the mercy of the desiccating powers of the sun and wind.

V. CONCLUSIONS.

We have endeavoured in our report to deal briefly with the subject of the influence of forests on climate, water conservation and erosion, both generally and with special reference to South Africa. We have pointed out the evils resulting from the destruction of the natural cover of the surface of the earth and the misfortunes which have arisen from such destruction. We have reviewed in a general way the much discussed question of veld burning. We have considered to the best of our ability in the short time at our disposal certain complaints received regarding the alleged decrease in local water supplies due to tree-planting and have recommended a scientific investigation of the whole subject. We consider that South Africa has a unique oportunity of carrying out such a scientific investigation which would be of inestimable advantage both to it and the world at large and which might allay certain fears which the public have expressed. Similar investigations should be conducted in other parts of the Empire.

For ourselves we are satisfied that the planting operations of the Forest Department can have had little or no effect on the general water supply of the country and that any effect they may have had has been beneficial rather than detrimental. We consider that the afforestation policy which has been pursued by the Government of the Union for many years past has been of the greatest benefit to the country by employing large quantities of labour and creating out of land otherwise unproductive, a valuable public asset which should later on support a prosperous local industry.

Lastly, we appreciate the concern of many people for the preservation of the natural forest and flora of South Africa which should be the special care of the Forest Department. We are aware of many areas which have been reserved by the Forest Department for the preservation of the natural flora of the country, and we hope that this policy will be continued. There is ample room for the indigenous forest, the natural flora and the plantation, and there is no reason why their interests should clash.

We hereby acknowledge all the help we have received in our labours both from the extensive published literature on the subject and from the gentlemen who have placed their views before us. We trust that our report may be of some assistance to the Government of the Union, at whose special request it has been prepared.

(Signed) C. G. TREVOR (*Chairman*).
J. R. AINSLIE.
W. F. BALDOCK.
N. V. BRASNETT.
E. H. FINLAYSON.
A. V. GALBRAITH.
J. D. KEET.
A. O'CONNOR.
R. S. TROUP.
R. W. THORNTON.

ANNEXURE. I.

VERBATIM REPORT OF CONFERENCE DEBATE ON FORESTS IN RELATION TO CLIMATE, WATER CONSERVATION AND EROSION.

Sixth Session, Wednesday, 11th September.

Held in the Provincial Council Chamber, Pretoria, at 9.30 a.m.

FOREST INFLUENCES.

(*a*) Soil Erosion.

(*b*) The effect of Afforestation on Water Conservation with special reference to South Africa.

The Chairman: Although the subject we have to consider this morning is in two parts, we have agreed to call the whole subject "Forest Influences", and I believe it will be of advantage not to separate it into two parts but to deal with it as a whole. This morning we will approach the subject in open debate, and you will be at liberty to speak, at a length of time not exceeding fifteen minutes, on any aspect of the question. I hope that as many as possible will take part in the discussion.

Mr. C. G. Trevor (India): In opening this debate, I would draw the attention to the papers which have been submitted to this Conference. I hope you have them all before you, including the excellent contribution by Mr. Stockdale, the Agricultural Adviser to the Secretary of State for the Colonies. I have many times been likened to the prophet Jeremiah, who spent most of his time preaching evil things to a sinful world. Prophets are generally cordially detested, Governments view them with suspicion, and the crowd who are accustomed to listen to the honeyed words of politicians, telling them that they are the heirs of all the wisdom of the ages, resent having the follies of mankind and the iniquity of their ways pointed out to them. But generally speaking, it must be admitted that prophets have prophesied what has come true, however much they may have been disliked in their lifetime. No doubt Jeremiah can now turn round to his contemporaries in the place where he has gone, and say to them "I told you so"; if that is any consolation to him.

Now, gentlemen, we are called upon to discuss a very serious problem. Ever since our arrival in this country the importance of erosion has been placed before us by all the public speakers to whom we have listened, and it is a good sign that in this country, at any rate, public notice is being taken of the evils of erosion, and of the importance of taking steps to do something to mitigate this evil and the future dangers that will be entailed by a policy of neglect. Representing as I do one of the older countries of the world, I propose in the short time allowed to me to give you a picture of the result of disforestation in the ancient world. If you read history you are bound to believe in the prosperity of these ancient kingdoms

and if you compare that ancient grandeur with their present decay, and their ancient wealth with the amount produced to-day, you can only be driven to one conclusion, and that is that the present decay of these countries is very largely based on the deterioration of the moisture that lies in the earth. Now, just imagine for a moment, what has happened to Persia for instance. Take the palace of the King of Kings, Darius, who at one time reigned practically over the whole eastern world. Can you imagine a man occupying his position, building his palace in the desert. But to-day, if you see the ruins of the palace of Darius in Susa, they stand in an uninhabited wilderness. Mesopotamia, which for generations produced all the revenues of Persia, by which that country was able to wage war against the Romans, has degenerated into a dreary waste and the hanging gardens of Babylon are a rubbish heap. No doubt the degredation of Babylon was partly due to the destruction of the irrigation works by the invasion of the Mongols, but already at that time, the irrigation system of Mesopotamia was in a state of decay on account of the destruction of the forests on the hills, and the bad régime of the Tigris and Euphrates which supplied the water for the finest irrigation system in the world, a vast system with which the Punjab at the present day cannot compare. The same history is repeated all over the world. In Greece, Anatolia and Spain, the destruction of the forests has seriously interfered with their climate, with their cultivation, with the moisture content of their soil, on which in the ultimate end, every nation and every kingdom depends. So much has this been the case in ancient history that it has been stated that disforestation, by the lowering of the moisture content of the soil, thus decreasing the water supplies of the country, has done more damage than any war, and has resulted in the destruction of the greatest Empires. I do not intend to-day to do more than pass in survey the history of the ancient world.

My colleagues from India, from Canada, from Australia and from Africa, will deal with the effect of disforestation in their own countries. I will confine myself to a few words about the effects of disforestation in India of which I have personal knowledge. Before the advent of the British in India, the area of forests was very considerable. Cultivation was precarious, and the keeping of live-stock was a hand to mouth existence, because a man never knew how long he would be able to keep his cows, owing to wars and famines. Consequently, the destruction of the forests did not proceed at any great speed. It is chiefly due to the introduction of peace in India, owing to the British occupation, that the population there has vastly increased, and that far greater demands have been made on the forests for cultivation, for firewood, for grazing, and for one thing and another, so that the destruction of the forest area, or rather the diminution in the area of the forests within the boundaries of India, has been going on at a very great rate, during the last 150 years.

To give you an instance, when the Emperor Jahangir built the castle of Nurpur for his Queen, Nur Jahan, the Light of the World, he writes in his memoirs that the forest was so thick that a bird could hardly spread its wings.

But if you go to that place to-day, you will see nothing but a denuded hill-country, with hardly more than a few tufts of grass and thorn bush, on which a few goats eke out a miserable existence. All that has happened in a period of not more than 300 years; in that

time the dense forests which clothed the outer Himalayas have been reduced to a negligible amount. The Rajah of Kangra, himself the descendant of a very ancient line of kings, told me that they still point out where the machans or shooting butts were placed in the days of the Maharaja Sansar Chand. To-day those surroundings are as bare as this floor, there is hardly cover for a hare, let alone for a deer. It was in 1852, after the annexation of the Punjab, that we in our enlightened manner gave away all the outer hills to the villagers. Before our kind action in this respect, they were the hunting grounds of the nobility, but having conquered the country, we thought is expedient that all the waste land surrounding the villages should be handed over to these people for their mutual benefit. But what have they done? They have utterly destroyed the whole vegetation of the hills by burning, cutting and grazing. I would ask you to turn for a moment to the illustrations at the end of the paper for India, which are more eloquent than any words of mine, of the appalling consequences of such action. You will see from those illustrations on Plate I, the entirely eroded surface of the outer Himalayas. You will see the remains of the vegetation, and if you turn to Plate II, you will see the cattle endeavouring to obtain some sustenance from the so-called grazing area. In the bottom picture you will see an assembly of the local villagers, protesting against the closure of their particular area of grazing, and if you examine the ground you will see that there is on it not a living thing, not a living leaf on the tree which has been lopped to feed the last of the goats.

If you will turn to Plate III, you will see what you might imagine to be a watch-tower, but it is not. It is a well. When it was built it stood in cultivated land. The level of the land was naturally where you see the top of the well, and what you see before you is the remains of the well standing in a dry and sandy river bed. All this is entirely due to the erosion and denudation which has taken place on the outer hills to the Himalayas, subsequently to the year I have mentioned, when these areas were kindly given away to the local inhabitants to do what they liked. Erosion may be summed up as ill-treatment of the suface of the soil. (Hear, hear). Whatever the cause may be, and there are several causes; first of all, in my opinion, comes the destruction of the forests by mankind, which has so often turned a garden into a desert.

Now, gentlemen, before I close, I would like to commend to you a few words from the preface to the "Arabian Nights". "The lives of former generations are a lesson to posterity, that a man may review the remarkable events which have happened to others, and be admonished, and may consider the histories of people of preceding ages, and all that hath befallen them, and be restrained." If you and the Governments of the countries you represent will only realise this fact, and will consider the histories of people of preceding ages who have destroyed the virgin covering of the earth and what has in consequence befallen them. If you will take steps to see that in these enlightened days the same fate does not overtake us as has overtaken other nations, perhaps in a thousand years from now, the world will be in a better condition than it is to-day.

Mr. A. V. Galbraith (Victoria, Australia): In my paper on soil erosion and allied problems as affecting Australia, particularly those comparatively thickly populated parts influenced by the Murray

River and its many tributaries, I have dealt with the two main forms of erosion, first of all water erosion and secondly aeolian erosion. Generally principles of cause and effect, and possible remedial measures for control of excessive erosion have been so frequently discussed that recapitulation here is unnecessary. Approximately 36 per cent. of the Australian Continent falls within the ten inch isohyet, therefore, water supply is one of our greatest problems, whilst most of these more arid regions are of comparatively little economic value at the moment, bordering upon them are fertile lands requiring only a well-regulated water supply to carry prosperous settlements of people.

The Murray River drains an area of no less than 414,253 square miles affecting Southern Queensland, New South Wales, Victoria and South Australia, or one-seventh of the entire mainland of Australia. If we add to that the coastal strip between the Murray and the sea, it would comprise one-fifth of the country, carrying 75 per cent. of the present population. Of the whole of the Murray River catchment area, only 158,500 square miles make any effective contribution to the volume of the river. The most reliable parts of the catchment are those high-lands where the waters have their source. Here, the rainfall exceeds 60 inches per annum with snowfalls in the higher regions. It should be mentioned here that in Australia there is an absence of very high permanently snow-capped mountain ranges, so that for the most part, we are dependent upon rainfall, the greater part of the catchment lies partly in Victoria and New South Wales, the highest peaks being Kosciusko, 7,228 feet, and Gibbo 5,764 feet, and Bogong 6,508 feet. Now dealing with the most important factors which contribute to the destruction of vegetation on the watersheds, that is grazing, above the 5,500 feet level there occurs a heavy covering of snow grass with intermittent stands of snow gum (E. coriacea).

A century ago these rich grazing lands of the Upper Murray, attracted settlers, and since those days practically all the country below the level of 2,500 feet has been occupied. The balance extending to the outlying grassland is held by grazing licencees, and it has been the practice of these licencees to burn out the rank grass in late summer, to encourage sweet undergrowth in the following spring. Now these uncontrolled fires sweep into the channels and gulleys, destroying the beds of moss and heath which provide storage whence the streams of water are fed during the summer period. The result is that increased run-off occurs in the winter and spring with a rapid diminution of the flow in the summer time. In addition to that, the burning of herbage and other vegetation is followed by heavy falls of snow, and serious erosion occurs from sliding snow-drifts down the mountain-side, thereby denuding the lower areas. In addition to that, where denudation of trees and shrubs have occurred through burning of this herbage, erosion becomes a very serious matter. On many square miles of country, the soil has disappeared, and the surface of the ground is covered with underlying schistose rocks. Deep dongas, as you call them in this country, sometimes 30 feet deep and 130 feet wide, have been cut through the valley loams to bed-rock. This represents not only loss of the richest soils, but loss to the catchment of the storage capacity of the deep loamy beds which retain the winter's supply of the summer water flow. These gulches are like huge storm channels, hastening the discharge

f the unchecked floods, and as these waters rush along to lower evels, the beds of the streams become choked with debris and the urrent is then forced to tear out new channels through valuable lluvial land. The finest soil particles are carried on in suspension o deplete the storage capacity of the main streams and reservoirs y siltation.

Now we have a striking example of what occurs in areas of lower ainfall in the Eastern Gippsland part of our State. There is a town here called Bruthen which is situated about 9 miles from the mouth f the river Tembo. Now, even 30 years ago, steamers were able o navigate this river to Bruthen, but consequent mainly upon the estruction of the vegetation on the highland areas, the river has ow become merely a series of water holes in the summer time, and he steamers have not been seen there for many years. Then we ave the area known as the Beech Forest in the Otway region in the outh-western part of Victoria. This is situated at an elevation of ,000 feet with a rainfall up to 80 inches. This area was well covered ith very valuable forests of eucalypts up till the eighties, when he catch cry of the politician of the day was " Settle men where he big trees grow " which proved a fallacy. The result has been hat the excellent tree growth on this elevated country has been lmost destroyed. The greater part of the land has been now prac- ically abandoned or taken over by the Crown. The Forests Com- nission is endeavouring to re-forest those areas especially which form aluable water catchments.

The settlers used fire as a servant but it became a very bad naster and burnt the tree cover, then the underlying scrub, and inally they burnt the grass itself. As a result, in many parts the ubsoil of clay is showing on the top of the mountain-side, the top oils have almost entirely disappeared.

The Forests Departments of Victoria and New South Wales have onducted reconnaissance surveys on the River Murray watershed, nd we have come to some conclusion as to the means by which we nay be able to do something to remedy the trouble. The suggested nethods of dealing with the question are, firstly to carry out a letailed survey and land classification to determine the most economic se to which each portion of the catchment should be put, and delineation of the sectors which are required to be maintained perma- ently as forests. Secondly, the vulnerable sections of the catchment rea should be dedicated as forest reserve, reforestation of denuded reas should be carried out and, if necessary, the resumption of rivate lands by the Crown should take place for this purpose. Thirdly, adequate provision for protection of forest areas from fire. Fourthly, revision of the methods under which highland areas are eased for grazing. And finally provision to be made for subsidiary ontrol measures, such as river plantings and establishment of minor tructures on upper reaches of streams to prevent further erosion ending improvement to highland sectors. I might say in passing, hat certain Victorian mountainous forest areas were grazed for many ears, but the Forest Commission three years ago, cancelled the icences and substituted a system of agistment under control of forest erdsmen. There was, however, intense opposition to that proposal, ut notwithstanding this no fires have occurred on the forest area referred to, since the new system was established, thus giving en- couragement for its extension. Our experience has been that burning,

either in the forest or elsewhere, means eventually killing out the grass, impoverishing the land, and thus diminishing fertility by baking the top soil, and promoting useless scrub. In other words, it upsets nature's balance to a very marked extent. Dealing with the question of wind erosion in the north-western portion of Victoria, we have what is known as the Mallee region, which consists of a raised estuarine plain, slightly undulating and representing about one-fifth of the area of Victoria with a rainfall of 10-15 inches. This region penetrates into South Australia and New South Wales. The total area of Victoria is 56 million acres, so you will gather that the total area of the Mallee is 11 million acres. The growth on that area mainly consists of stunted eucalypts but on the choice raised areas Callitris (Cypress pine) occurs, Victoria's only softwood. Wheat grows very well on these pine areas and the result has been that settlement has taken place to a marked extent in the last 35 years. In order to clear the land farmers have rolled out the Mallee and have destroyed the Cypress pine trees. A wise provision was made by the Lands Department in early legislation to reserve 3-5 chain breaks carrying tree growth between each area settled, also on the roads, but as recently as 10 years ago, Parliament decided that these forested strips between allotments could be taken over by adjoining settlers. Unfortunately this was largely availed of and the tree growth destroyed. The result has been that wholesale wind erosion has occurred and farmers are actually losing their seed wheat after sowing as well as suffering other disabilities.

On a small forest reserve in the centre of this settlement we are now working on our third tier of boundary fencing, the original fences having been covered by drifting sands; this has all happened within 30 years. In many parts, where we have endeavoured to plant trees on vulnerable sectors, we got very good growth perhaps for two years, and then a bad sandstorm comes along and absolutely covers the trees. A Joint Committee consisting of the Lands Department, the State Rivers and Water Supply Commission, and the Forest Commisison, investigated this great problem and as a preliminary step to the reforestation of the bad sectors, these were the recommendations of the Conference: The area to be maintained under natural vegetation, from 3 per cent. on 640 acres, to a maximum of 6 per cent. on 1,280 acres, where the larger areas contained soils more liable to blow on account of the sandstorms. Secondly, the burning of stubble to be prohibited up to within 5 chains of the water channel or other work. I may mention that it costs the Government from £60,000 to £100,000 in bad years to keep the water channels clear of sand. Thirdly, the prevention of ploughing within three chains of a channel or other work, and fourthly, in letting out sub-divisions of Crown lands the provision of trees on roads should be carefully considered from the point of view of maximum timber protection from drifting sand. These are the recommendations which have been put forward by the Committee, in an endeavour to bring about vegetative growth on the bad sectors.

Finally, I would say they must be very arid indeed, before we would consider not placing tree-growth on the vulnerable land features of the State. We consider that the prevention of soil erosion is of paramount consideration.

Mr. J. D. Keet (Union of South Africa): In presenting my paper on the question of erosion and allied problems in South Africa, I need not remark on the importance of the subject before this Conference. This has already been done in far abler words than mine, spoken by Mr. Trevor and others who have already addressed you. I have not dealt with the cause and effect of erosion in South Africa at any great length. These matters have been so thoroughly investigated and are so well known and generally admitted, that a bare summary thereof will be sufficient for our purpose. Hence, I have rather sketched the policy of the State in regard to this question, as well as the steps that have been taken by the Government to secure the reclamation of eroded land and to prevent further soil erosion as well as to protect our major catchment areas.

Our legislation dealing with veld burning is reviewed. I have also touched on the question of drift sand reclamation in South Africa. In the case of both erosion induced by water, and erosion induced by wind, it is, as Mr. Trevor has very ably pointed out, mismanagement of the soil, of the veld, and of vegetation generally, often amounting even to abuse, that is the cause of all the trouble. I will not deal with those evils any further but I will rather proceed to say something about the other question before us, namely, the influence of the forests on climate, soil, and water conservation, and I will deal more particularly with the influence of forests on the water supply in South Africa. In order to understand the controversy that has raged on this question in South Africa, I may perhaps be permitted to offer this Conference a few general remarks on the climate of South Africa. The desiccation of South Africa—I use this word to denote the change for the worse in our climate, in other words the approach of the desert—has exercised the minds, both of scientists and laymen for a considerable time. Many have been the attempts to prove that the desert is really encroaching on us, and careful observers have pointed to desiccation in South Africa, illustrating their contentions by the hippo pools that are no longer in existence except in the form of dried up holes in the river beds, and to the disappearance of our forests which formerly formed the habitat for various wild animals such as buffalo and lions, and generally to the destruction of forests, and the approach of arid conditions in the areas which formerly held a far different type of vegetation.

But this has been measurable more in terms of retrogression of the flora, sinking of the water table and of the drying up of vleis, springs and streams, with the consequent loss of stock and crops, and even the migration of the population that in terms of actual rainfall records. It was not until quite recently that proof has been forthcoming that there has been a pronounced secular change, a marked downward trend in the rainfall in several parts of the country, and the fact can no longer be denied that there has been a diminution in our rainfall during the past 40 or 50 years. The effects thereof have admittedly been aggravated by wrong methods of treatment of the surface of the soil. I, personally, do not ascribe this change in our rainfall to the destruction of our vegetation, because in parts where our forests have been destroyed this has been counter-balanced by the establishment of plantations over a very large part of the country. It seems to be questionable whether the mere deterioration of our grass land and scrub vegetation, can have affected our rainfall to such an extent. The factors governing our rainfall are probably

far greater, and actually lie outside South Africa altogether. These are matters which we hope will right themselves in the course of time. Apart from secular changes, the South African climate is also subject to very marked and sudden fluctuations over shorter periods, and we have now at least come to realise that drought in South Africa may always be with us to a greater or lesser degree. This is the reason why steps are being taken in the form of anti-soil erosion measures to prevent further exsication (the drying out of the subsoil and the sinking of the water table) thus to ameliorate in one sure way the sication of the country: the drying up of both soil and climate. I do not know how to express this so well in English as in Afrikaans, but we have a very descriptive term which applies to these conditions. It is the word " Verdroging ". I can only translate it in English by saying it means " Drying out " of both the climate and the soil. Now, we foresters seek to prevent the sication of the country by preserving the vegetation and by increasing the area of the forests, in the firm belief that there is no better agency by which to secure this object. We regard the mature forest as the best preserver of both climate and soil, and we also regard good forest soil as the best reservoir for water. In this we are guided by ages of experience in all parts of the world. It is not the maximum quantity of water, however, but the maximum beneficial yield of water that we are after. We cannot cater for the demands of those reservoir engineers, who realising that all plant growth, like all living matter, must use up water to live and grow, demand catchment areas paved with bare rock or land covered with malthoid. We have to bear in mind the lesson of those French engineers who once deforested their pine covered catchments to increase the run-off for their reservoirs and canals, but have at the cost of many millions of pounds been obliged to reforest these same areas, and with those same species of pine and other conifers that once grew there, when as result of the deforestation their reservoirs became silted up and their canals stood dry. It is not quantity only, especially in the absence of filtered storage, which makes up water-supply, but also the control and utility thereof, and it is not vegetation, but soil as the product of decomposition of vegetation, and of climate, that is the reservoir for rainfall. The retention and protection in this country at great cost, of uneconomic grass land or scrub vegetation—I will not use the misnomer " macchia "—on water sheds on sites where forests can be grown profitably, is to my mind a questionable policy in the political economy of the nation. But our forests and plantations stand suspect. The significance of the mighty words of Humboldt that " by felling trees, which are adapted to the slopes and summits of mountains, men in every climate prepare for future ages at once two calamaties: want of wood and scarcity of water " seem no longer to be realised or heeded. One can appreciate the apprehension of the layman, accustomed to the popular notion often overstated that forests increase rainfall and water supplies, when during periods of sub-normal rainfall, such as we have experienced for some years now, streams in both forests and plantations diminish in flow and dry up altogether. But the attitude of the scientist who urges these facts, without co-relating them to our rainfall and the drying up of streams and adjoining non-forested land, is less understood. Some have maintained that the soil under plantations of pine is bare and subject to erosion, and that the plantations will sooner or later turn

South Africa into a desert. I say that in this respect the forests stand suspect. It is known that trees dry up swamps. Indeed, trees are actually planted in order to drain swamps, for example in malaria areas. It is coming to be realised by some people that forests cannot be grown in deserts, even where country now desert was formerly covered with forests, the suspicion seems to be growing that it is not the destruction of forests which promoted the desert condition, but that it is, or may be, the forests themselves that dried up the water supply, and thus created conditions under which they can no longer live. It is also coming to be realised that they do not make rain, but that they follow rain. We have many species of alarmists in this country. We have had, and may still have what I may call the Kruger alarmist, as well as the Hoggenheimer alarmist. We hope, however, that they are dead, but we still have other species. For instance, we have the climate alarmist, the donga alarmist, and the veld-burning alarmist. We foresters will find ourselves in better company with these latter without necessarily subscribing to the views and remedies suggested by extremists. But we have still another school of alarmists in this country, new to South Africa. That is what I may call the Forest alarmist—the forest alarmist who regards grass and veld generally, as more efficient agents in conserving the water supplies of this country. I hope as we go through South Africa, we will have sufficient opportunity to observe, and to find out for ourselves, that the suspicions or the alarms of these people are not justified. It is known further that the surficial run-off coefficient from denuded area is actually increased by a few per cent. and over a few years, at least until the soil becomes degraded and your springs dry up. It is also known that a thick mantle of lowly herbaceous vegetation can approximate in value the effects of a forest in preventing run-off and erosion, and that the water table in forests may be lower at times than in areas which are non-forested, but it seems to be overlooked again that the moisture content of forest soils is more constant. It is our plantations, especially, that stand suspect. They are accused of being ecologically foreigners to our climate, and South African foresters are accused of confusing natural forest conditions with exotic forest conditions, and that generally we have ignored the ecological outlook.

But, just as a farmer does not plant the exotic apple in the low veld, or the exotic citrus on the high veld, so we foresters also do not plant exotic cluster pine on the coastland of Zululand, or the exotic saligna gum on the mountains of the Free State. I think the South African forester to-day can claim to teach the world something about the knack of matching species to growing sites, and I think our foresters need stand back to no one so far as working in conformity with ecological principles is concerned. Without this, we would soon have no forests at all. Mistakes have no doubt been made, but these do not condemn forestry as such. The forester lives with nature, studies nature, and follows nature's law, and if that is not ecology, I fail to see what ecology can be. I hope that after all ecology is not merely a case of adding new words to our vocabulary. There is one thing we have still to be convinced of, and that is that exotic trees acclimatized to their new home, are any more desiccators of the soil and climate, than they are in their native habitat. What we South African foresters do know is that exotics in South Africa, both the gum and the pine, and even the wattle, often act as pioneers to

our indigenous species, even to the moisture loving ones. This fact is very encouraging to us, and shows us more clearly than any measure of soil moisture and light intensities and temperatures and so on, that we are on perfectly right lines with our exotic plantations in South Africa. (Hear, hear.)

We are confident of the future and of success. We know that we have not the whole of the South African people behind us. but we feel perfectly sure that we shall gain their support.

Mr. J. R. Ainslie (Nigeria): It seems to me that in this Conference, I am fated to deliver supplementary reports and typescript, as well as printed reports prepared by the Government. In this case the supplementary typescript report was asked for after the published report was prepared, and deals mainly with historical and other records of desiccation in West Central Africa; the printed report deals with Nigeria alone. Now, Nigeria is not as a great many people imagine simply a huge swamp formed by the delta of the River Niger; there is a huge delta, it is true, but behind the delta lies a vast extent of country, nearly 300,000 square miles of higher land mainly covered with Savannah forests; these Savannahs stretch right across the continent of Africa from east to west and north and south from Kenya to the Cape. Because of this, although I speak only in regard to Nigeria, I feel sure I shall also be describing to a large extent the conditions in a great many other central African countries, not only those within the British Empire, but French and Portuguese colonies as well. Throughout the territory of Nigeria erosion is always going on. The main factors are rain and wind; those factors are, however, supplemented by powerful contributory agencies in the shape of bush and veld burning, ever increasing shifting cultivation, and minor agencies such as solar heat, etc. Now, regarding rainfall, we have in the south of the country at one point the extraordinary high annual precipitation of over 360 in. a year. The coastal average is, however, only about 100 in. and this figure as we leave the coast falls off rapidly until in the extreme north we drop as low as 12 in. to 15 in. Strange as it may seem, it is in this region of from 10 in. to 20 in. that we get the worst erosion. In the winter months in the latter region there are the strong fierce desert winds, which drive along and pick up the soil, from which all protection has been burned off by veld fires; it is carried off to be deposited on the dry stream beds, to form sand drifts, or to fall into the larger rivers to be washed down to help build up the Niger delta. This wind which is called the Harmattan is at first a cold wind but is usually followed by an intensely dry hot season; the wind changes from a cool dry one to one which can only be likened to a blast from a furnace: that is the only way to describe it, and the result is that at this time of year the conditions, in the northern part of the country especially, become rapidly more and more desert like, as the dry season goes on, and it must be remembered that the Sahara itself is only a few miles distant. Following the long dry season comes a short rainy season; the rains come down in torrential downpours, and these assisted by wind-blown water and tornados carry the soil into the rivers. After one of these severe downpours, the water in the rivers is like liquid mud; it is of the consistency of thin porridge. By these two agencies then our surface soil is carried away twice in the year. The porridge-like water is carried down the rivers but as

the gradient decreases much of it is deposited by the water, and it spreads out over the agricultural land or fills up the river beds. This exposes a bigger surface to evaporation and causes further deposition, and so the process goes on with increasing effect. Most of Northern Nigeria was at one time much more densely covered with forests than it is now, there are still remnants of these forests, but there are obvious ecological indications that it has deteriorated, and is still suffering degradation. Mesophytic trees can no longer reproduce themselves; they are being replaced by dry zone species; dry zone trees are giving way to those of the arid zone and over considerable areas the zone is being occupied by desert conditions.

Mr. Trevor made reference to ancient kingdoms in Persia, India and other parts of the east; we too have had them in North and Central Africa: A few months ago I had the opportunity of visiting the French Niger Colony lying to the north of the Nigerian boundary; that country is very largely desert and includes within its area probably the most dreaded desert region in the world; nevertheless throughout the country there are many ruins of ancient towns and villages; it was evidently at one time heavily populated, and so must have been a well watered region. There are both Arab and French records to show that up to the middle and towards the end of the 18th century at all events these towns were inhabited by an active farming and trading people; the area, however, became disforested and it has only taken some 200 years to depopulate a country as large as the Union of South Africa. On the other hand, we have certain geologists who maintain that because there are no records of a fall in the water level of the country, or because it has not been lowered there is therefore no desiccation; there are others who say that in the 25 years records that we possess there is no evident diminution of rainfall, and that therefore desiccation is impossible. Gentlemen, the water table of the country is some 50 feet below the surface; but whether it is 75 feet or 100 feet or 20 feet, it does not matter; man or beast and plant cannot reach it and all the time the vegetation is going back. The old historical evidence supports the ecological evidence, and does not corroborate the geologists views. First came the shifting cultivator with his axe and fire; secondly the grazier with his camels, cattle, sheep and goats as well, and now comes the desert. We know, of course, that there have been contributory causes to the depopulation of this great region, there have been raids, war, plague and certainly there has been famine, the last named due to disforestation; but it is impossible that these can permanently turn the country into a desert: the fundamental cause remains always the same—forest destruction.

When I say " now comes the desert ", I think I should explain that I do not mean the Sahara is a mobile, rolling sea of sand engulfing the French Niger Colony and about to engulf Nigeria; nor do I mean that the Sahara itself is actually encroaching on Nigeria: What I do mean, however, is that in Nigeria the climatic conditions are in the northern part of the territory rapidly approaching Saharien conditions. You must, of course, appreciate the fact that the matter as one of very great concern, it is virtually a slow disaster, but although it appears a slow process during a man's lifetime, it is an extremely rapid process in the life of a nation, and possibly, I may say, in the life of this continent. Preventive measures have been taken on a small scale, and although in some quarters they have been

compared with King Canute's effort to stop the tide, they have been in a measure effective. Indeed, they have been so far successful that the French Government which controls the adjoining colony have been attracted to them, and have approached the British Foreign Office with a view to the two Governments co-operating in measures to combat this serious menace common to both countries. It is a menace which, if unchecked, will in time destroy not only the French African colonies, but some of the fairest, most populous and most fertile provinces of the British Empire. Perhaps I may be permitted to conclude these brief remarks by quoting a very short but very apt warning taken from the 20th Chapter of Deuteronomy: it runs thus: " Thou shalt not destroy the trees, and thou shalt not cut them down, for the tree of the field is man's life ".

The Chairman: That concludes the presentation of papers. I will now call on members to take part in the general debate. I will call upon Mr. Finlayson to open the general debate.

Mr. E. H. Finlayson (Canada): Mr. Chairman and gentlemen, during the first days of this Conference I have been wondering just when our good friend, Mr. Trevor, would start making his allusions to the Bible, as at previous conferences, he gave us a number of appropriate and authoritative references to the Scriptures. Perhaps I was brought up in a more religious home than was Mr. Trevor and because of such rigorous up-bringing it has not been my practice to go to the Scriptures for my recreations: it is perfectly obvious that, in regard to the Old Testament at least, Mr. Trevor is an authority, and as Shakespeare said, he can " cite the Scriptures to his profit ". (Laughter.) Probably in his later years, Mr. Trevor will write a " Book of Revelations " of his own.

It is my privilege to speak on this important subject with respect to Canada. Our country is relatively speaking, a young one, in so far as settlement is concerned. Development has been confined entirely to the past 250 or 300 years. Indeed, our intensive development has taken place during the past 100 to 150 years.

Mr. Trevor dealt with the subject in a general way and then applied it to India. Other speakers have dealt with conditions in their own countries, and have covered pretty thoroughly the various phases of the question. I propose to make a few references to Canada with perhaps a few general remarks applying to the North American continent as a whole.

I shall start with Eastern Canada, not right at the Atlantic Coast, where we have Novascotia and New Brunswick. The latter are comparatively small and fairly densely populated provinces, and they are also fairly well wooded. I shall therefore start with the Province of Quebec, which Province is divided by that greatest of waterways on the North American continent, the River St. Lawrence. Both to the north and south of this great river we have had from the early days settlement of agricultural land. The system of development in the early days, in order that the French settlers might be protected from Indian attacks, was that they should develop their homes quite close together on or near the shores of the river, their farms being comparatively narrow strips stretching far back into the country behind. That system brought about very intensive settlement along the St. Lawrence River itself. I am now speaking of the actual bottom lands, the areas immediately along the St. Lawrence River.

A little back from the river, the land rises and there are heavy stands of mixed hardwoods with an admixture of conifers. In various parts of the province there are numerous areas, some large and some small, where sand dunes have been formed, a result of clearing land which ought to have been retained under forest cover, for two reasons, first that they were not really susceptible of successful agriculture, and secondly, in order to protect adjoining good agricultural lands from soil drifting the lighter lands should have been left under timber. Several members of this Conference, on their visit to Canada in 1923, themselves saw the sandy areas to which I have referred.

In Quebec, although we have not hydrometric data extending over a sufficient period of years to enable us to draw conclusions, it is nevertheless perfectly obvious to anyone who has travelled in the province that not only has the clearing of lands which should not have been cleared resulted in the reduction or disturbance of the stream flow, but timber operations in the hinterland have also had an effect in this direction. The country lying behind was exceptionally well wooded; it is there that extensive operations for the production of timber for lumber and pulp and paper manufacture have taken place for a great many years, and where also unfortunately fires have done great damage. As I say, it is perfectly obvious to anybody who has had the opportunity of looking at these lands, 25 or 30 years ago, and to-day, that there has been an appreciable disturbance to stream flow.

Now, taking the next province, Ontario, I shall refer briefly to three specific instances. In the first place, there is the area known as the Trent Water Shed, which was settled upwards of one hundred years ago. The Trent River drains into Lake Ontario about the middle of its northern shore. This also was a territory of very dry and more or less light sandy soils. It was settled as I say about 100 years ago, and for many years farming operations there were carried out with an almost constant decline in the success of the agricultural operations. Arising in that region, we have what is known as the Trent Canal, the water for which was to have been drawn from the Trent River itself and from various other rivers which are found in the district. I need only say that the Trent Canal has been largely an unsuccessful venture. I do not attribute that entirely to the denudation of the forests in the district surrounding it, but certainly that condition has contributed to it.

The second instance to which I would refer is further west, namely, in the valley of the Grand River, a river that drains a substantial part of what we regard as older Ontario—that is the more settled part of the province. This river drains into the second of the great lakes, Lake Erie. I have never actually lived on the Grand River or on any of its tributories, but I do remember as a boy being taken over parts of Middle Ontario by my father and others, and visiting small towns and villages on the various tributories of the Grand River. Between then and now, is a period of some 39 or 40 years, and I can assure the Conference that there has been a tremendous change in the conditions all through that country. Substantial towns and cities that were built up on the various parts of that river system, have been subjected, particularly within the last ten or fifteen years, not annually, but very frequently—perhaps once in three years or so—to very serious floods; and these have done great damage to these towns and cities, and also by reason of the erosion to the surrounding agricultural country. I need not describe

in detail another river which drains the western part of Ontario, the Thames River system, where conditions are similar to those I have described.

Now, just for a moment, combining the conditions existing in the two provinces to which I have referred, Quebec and Ontario, we have to the south of both of them the great St. Lawrence River. For the past ten or twelve years the question of the depth of water in the river has been giving serious concern. The gradual lowering of the water has become what I might call one of the more serious problems on the American Continent, affecting both Canada and the United States of America. I feel sure that many of you have read proposals that have been made for the development of the St. Lawrence waterway. Recently it has become perfectly evident that there has been a gradual but perceptible lowering of the St. Lawrence River. Various bodies have met together and discussed the question and as recently as six or seven months ago we were called upon to give some consideration to it, and to advise, if we could, as to what effect forest denudation in the Ontario and Quebec Provinces and possibly in the adjoining territory of the United States to the south could have had on this question. We have therefore set to work in a preliminary way to deal with this problem, and we are now gathering together all the available data on the subject. It appears to be quite certain that even with the limited data available we are going to be able to draw some fairly definite conclusions—not conclusions, perhaps, which will have the effect of convincing extremist engineers, but which will, I think, be quite in accord with the views of other engineers who, while doing the utmost possible for their own profession, still see the need of natural methods of control; because, after all, over a long course of time, there is no doubt that it has been man who has disturbed the natural conditions of the country to which I refer. Before leaving the question of the St. Lawrence waterway, may I say that along this large river, which constitutes as far as the great lakes are concerned the international boundary, we have the older and more settled part of Ontario, and the settled part of Quebec, both on the north and south shores. And we also have the American States of Minnesota, Wisconsin, Michigan, Ohio and New York, all of which are very densely settled. We have the pineries of Northern Michigan and Wisconsin, or rather we had them at one time, because those pine forests are practically now of the past. Large portions of those States were seriously denuded, even more so than Quebec and Ontario. These conditions have contributed to the lowering of the St. Lawrence Waterway.

Now in regard to Western Canada, I shall be rather brief. In Manitoba, we have an area not far north of the international boundary, toward the western side of the Province where there are hills known as the Spruce Woods. This area was until the late eighties quite densely wooded. As a result of the indiscriminate cutting and timber-stealing that went on, the once extensive spruce forests were seriously denuded. This is not wholly the cause of the trouble, but right within the area itself there has been a very decided reduction in the water table, and also in the surrounding country.

In regard to the Province of Alberta, I can speak with more familiarity, because in it for many years I carried on my field work, and later had charge of the district. In Alberta we have the eastern slope of the Rocky Mountains, an area which is the fountainhead of

the river system of the western plains draining the southerly half or two-thirds of the Province. I think my friend Mr. Caverhill will recall that in 1910 he and I rode up the Elbow River not very far from Calgary. We then turned up a branch known as Canyon Creek. For some three or four miles we rode up the rough boulder1strewn bed of the creek. There were no signs of water, except here and there a few little pools. A few miles up the river we came to the stream which was losing itself among the bounders. Now the previous year there had been a tremendous forest fire in that district, and a few years previously there had been another bad fire. In the year 1910, of which I am speaking, after we were there—I had better say a month afterwards lest we should be suspected of causing the fire—the region was again ravaged by fire . For several years the conditions to which I have referred were present, accompanied by a lack of water in the lower reaches of the creek. This continued for some time, notwithstanding the fact that the years 1911, 1912 and 1913, were years of abnormal precipitation. However, as so often happens in our Canadian Rockies, we get a very good reproduction of pine with a certain admixture of spruce. In more recent years, I have on two occasions ridden up the Valley of the Elbow River and I have seen the Canon Creek discharging water at its visible mouth into the Elbow River. I do not say that this is entirely due to the influence of new forest cover, but I do say, with all the force I can use, that I am quite convinced that it was primarily the result of the re-establishment by nature of the forest conditions, not as they were previously, but rapidly working towards it. In the United States of America there have been similar experiences. I am not going to make any prolonged reference to that country this afternoon, because obviously we are discussing forest questions within the Empire. I may, however, make the general remark that the conditions which I have described as applying in the Provinces of Canada obtain also in various parts of the United States.

Before taking my seat, however, I should like to make a few general remarks. I have not been all over the world by any means. Perhaps I have not travelled to anything like the same extent as some others here. But one thing that has impressed itself upon my mind is this: Whenever I go to a country in an entirely different part of the world, at once I hear that the forest problems there are utterly different to those which we encounter in Canada. That was the case in Australia for instance. It was the case in the West Indies. It is the case in the Union of South Africa. It was also the case in the Hawaiian Islands of the Pacific, and so on. They say that the problems which they have to face are so utterly different to ours. Now, taking my own country, as between the forest regions of northern Saskatewan, Alberta or Manitoba and, say, the forests of New Brunswick, lumbermen in Saskatewan, for instance, will tell you that their Province is so utterly different to New Brunswick. It is quite true, of course, that there are points of difference, but I must say this, that when we consider this problem in its elements and when we get down to the basic principles of the thing, I have been struck rather with the points of similarity in the basic problems than I have by the points of difference. Mr. Trevor said yesterday that we cannot in discussing this question of forest influences leave out of consideration everything relating to climate, water conservation and so on. We must recognise that a good many of these problems

have engineering phases, and that some of them are in fact almost purely engineering problems, but as I said in my earlier remarks, there are engineers who do not take the utterly extreme view. There are engineers who fully recognise that forests can have a very beneficial effect on these factors that we are discussing. On the other hand, we as foresters must recognise in our consideration of this problem that due importance must be given to the engineering aspects.

The other day we stood on the margin of Mr. Holly's land near Maritzburg. We saw on one side a certain condition of things, and on the other side an altogether different state of affairs. There was no comparison between the results of what had been done on the one side and on the other. These results were evident to us all. We saw what had been done in the one case, and what ought to have been done in the other. There was no use in saying that if certain things had been done on the other side of the valley the owner would have had just as good conditions as Mr. Holly. The fact is that it had not been done, is not now being done, and I question whether it ever will be done.

The Chairman: Gentlemen, I think we might now turn the discussion a little more definitely, though not entirely, into the channel of South Africa. We have with us a number of gentlemen who are not actually members of the Conference, but who possess special knowledge of South African conditions, and I think I am expressing the general desire of the Conference when I say I should like them to take part in the discussion. Then, I think, we should hear members from other parts of the Empire who have precise examples to put before us.

Professor John Phillips (University of the Witwatersrand): There are some aspects of this important matter of erosion and of water conservation in relation to forests that I feel I must bring out, because so far, in the admirable discussions regarding water conserving and soil holding and other important influences of forests, these have been left out, with the exception of one remark by Mr. Keet which I feel I shall have to discuss somewhat. I only regret that the time at my disposal is so short, but I shall endeavour to cover a fairly large amount of ground in as short a time as possible. To begin with the aspect of erosion—the washing of the soil from one site and the deposit of that soil on another site, with especial reference to sheet erosion, I want immediately to say that no sensible man, be he a layman or a man of science, would suggest that our indigenous forests were in any way responsible for such erosion, but when we come to consider the matter of some of the exotic species that have been introduced into our country by the state, used by the state and used by private owners as well, I suggest to you that the matter requires rather more consideration. It requires investigation with an open mind. It also requires that we put into the background for the time being traditional concepts. I would remind you, first of all, that while I now go under the name of Botanist, I was trained in Forestry. I shall now refer more especially to the gums, the wattles, and to some extent to the pines. Those of us who have moved about more particularly in the semi-arid parts of the country where these species are planted for one purpose or another, must have noted washing in stands of these species where washing does not take

place in stands of natural vegetation, at any rate where that vegetation has been at all looked after. I am not going to enter into discussion of the complicated question of grazing and over-grazing or veld burning. We are foresters, and we are discussing the question in relation to forestry alone. But this erosion does take place, and it can be demonstrated; and if it does not take place in the better-watered parts of the country, there is no reason why those who are particularly anxious to plant such trees should close their eyes to the fact that it takes place elsewhere. Now with regard to water reduction, there are various points I should like to touch upon quite briefly. Emphasis has been placed upon the fact that a study of rainfall data suggests that there has been a considerable reduction in rainfall in the course of the last 30 or 50 years. This has never been contested. At the same time, I would suggest that this is a cyclic factor, and that when our rainfall data extend further we shall probably find that it is really a cyclic phenomenon and not allow ourselves to be unduly alarmed or terrorised by the cry about the approach of the desert. It may be that the desert is approaching, but it is being advanced by our mismanagement of veld, more so than by the broader phenomena that have been mentioned this morning. I should like to point out too, that while springs have ceased flowing or have been reduced in volume or flow in exotic plantations, quite frequently springs and streams in the open veld where that veld has been at all looked after, have not ceased flowing. In regard to the relation of water to trees, I want to say with special emphasis that those studies that we have carried out in this country most definitely show that the water requirements and the rate of water usage and transpiration are considerably greater in the gums, acacias, and the blackwood, and is considerable in the pine, as compared with those native shrubs and trees that have been investigated at the same time. I refer especially here to the specific conductivity of the tissues in tree stems—that is, the rate at which they transmit water through a given length and given surface and in a given time. It emerges now as a point of interest that a plant we have looked into carefully—*Pinus insignis*—is able in some of the drier conditions of the Transvaal, to use water all the summer effectively, when the water content of the soil begins to drop, the position being that there is an interesting change in osmotic suction force of the cell content, in relation to the drop in the water content of the soil. I want to stress the point, that we know from such data that these plants use up water at a rapid rate. It therefore behoves us to consider very carefully their use under certain conditions which I shall discuss in a few moments. In regard to soil deterioration and moisture reduction under trees, I can produce you figures for what they are worth. I can point in the field to vegetation conditions that most definitely support the plea that the gums and wattles, and in some instances the pines, are utilising a great deal of water, a far greater amount in fact than the indigenous vegetation in association with it. But agriculturalists, pastoralists and horticulturists can so often point out that grass herbage and fruit trees are either stunted, poor-bearing or die altogether within 20 or 30 feet of shelter belts of gums. You will find that near some of the belts of *Acacia mollisima* there is poor, miserable growth of native grass within 30 or 40 feet of a stand, whereas there is luxuriant grass of different species further away. These matters must be looked into scienti-

fically and dispassionately, when we consider the whole matter of the usage of exotics, and I ask you to give atteniton to this, and let us forget the theoretical concepts with which we are nurtured in the various forest schools of the Empire. And then again when we look into some of the soil conditions in relation to acacia and gums more especially, we find somewhat disturbing conditions in terms of water retaining capacity, aeration, of hydrogen-ion concentration or acidity. I do not say invariably, but in many cases the conditions are far less satisfactory than those obtaining outside such stands under natural vegetation of whatever kind it may be. Especially would I like to point out that much of the litter that falls from these exotics is not incorporated into the soil, but lies on the surface for a long period, ultimately very largely disappearing in gaseous form, not being incorporated into the humus in the soil. It has been suggested that by management of the stands, we shall be able to ameliorate these conditions. I would grant you that up to a point a change in management might make worse better, but I cannot grant that it will make bad very good or as good as the conditions under indigenous vegetation. I would ask you to cast your minds back to what you saw at Cramond and Broadmoor as regards the conditions of wattles managed on the new system in contrast to those managed on the old—where under a higher light intensity under the new method, there was upon the ground little or no weed growth, whereas under the old method there was definitely grass growth and in some case herbaceous growth as well. These conditions are due to a difference in the water content of the soil, and we know from experiments carried out—not with this particular species, but with other plants, notably grasses—these differences may largely be the cause of a greater use of water, the more vigorously growing trees being able to reduce the water content of the soil to a greater extent than those in more crowded stands. Again, it is asserted in a memorandum by our local Forest Department that foresters would claim that the pine plantation is the most powerful agent in the prevention of erosion. But I would like South African foresters to look at their indigenous scrubs, such as the fynbos and the *macchia* or maquis (which by the way is not a misnomer), and the conditions under properly managed grass veld—I can assure you that the indigenous vegetation is either as good as or better than these pine plantations. I personally have noted an amount of run-off, especially after heavy downpours, in pines, in the Knysna area, where under Pinus pinaster on a slope, after the initial fall there has been a considerable amount of run-off which has found its way to the indigenous forest below. It has been said also that the indigenous species, which require very congenial conditions before they will grow, even find their way into the exotic plantations. I know this, but I also know that this occurs only under certain sets of conditions. We must be scientific and present the whole picture, and not a partial one. It occurs where there is a large rainfall, where the plantations are in close proximity to forests, and where they have been developed upon old forest ground at no great distance from forests. But it does not occur elsewhere. It remains to be seen whether those plants that have come in, will be able to go through all the stages of development, more especially when periods of local drought intervene, because the water requirements of many of our indigenous species, I know from my own investigations, are

extremely high. The wilting point is soon reached, and it is reached before the wilting point is reached by the exotics. Then again, in regard to the incoming of indigenous species elsewhere, it has been claimed that indigenous plants, so called succulent plants, come in in areas like the Free State and Transvaal. But if we look into the matter, we find that what is happening is this—that pioneer grasses like Aristida, and probably pioneer herbs are under these stands of gums and wattles, whereas within thirty or forty feet of the margin of the stand there is a much higher type of vegetation—very much more demanding in its water requirements. It is all a matter of comparison. It is again said on page 5 of the Memorandum by the local Forest Department to which I have referred, that the best way to re-establish destroyed forests is to introduce exotics, especially pines. Well, I have worked in the indigenous forests of Knysna, George and the Humansdorp District. I spent five or six years there, and I also know something about forests in the Eastern Cape—I served there for several years. Mr. Chairman and Gentlemen, as a silviculturalist interested in indigenous forests, I put it to you that it is very definitely a mark of defeat if we, charged with the silviculture of our native forests, have to call in exotics to help us in that manegement, when we can find other methods which will give us the results required. I maintain that there are other ways of doing it. The natural way to extend our indigenous forests would not be to use these exotics, but would be to encourage the shrub and small tree stages of the natural succession—the *Virgilia capensis* in the South-Western Districts—the *Leucosidea* in Natal and other species in other parts, where by the natural process of succession, these plants would act as nurses, and with suitable thinnings should be utilised for the raising of young seedlings for full development to forest conditions. It is claimed that there is a very small area under exotics in the Union in comparison with the general surface of the country, and that is admitted, but surely that does not in any way argue that we should not give most careful attention to the reports, and to the conditions that can be demonstrated on the ground, regarding the reduction in stream flow and the drying up of springs where small wood lots in this way have been responsible for that reduction. It does not remove the onus one iota; it should all the more make us look into the matter lest we find where we have a large area of exotics we have done harm instead of good. There are local facts that are very definite and can be demonstrated, and that is why I am expressing the point of view I hold.

And now, finally, regarding policy; it is not much use saying that this is happening unless we can suggest some way of approaching the problem, and I put before you several points that I think are well worth consideration in this connection. First of all, we do need to know a great deal more than we do at the moment. The planting up of sites must be considered in terms of water supply: only those could contest such a policy who have sufficient data at their disposal. I ask you again to forget traditional concepts. Here we need long range research—we want to select certain catchment areas which will have a number of streams. We must investigate the régime and life-history, as it were, of these streams over a sufficient period. We must do this quantitatively, and we must work most critically and with a sufficient number of these, and treat them in different ways. We must consider their sources, and treat these

sources in different ways; we may plant the first source and manage it differently to the management of the other sources; we may protect the second source from fire, and let our native vegetation develop; we may burn the grass on still another source, and so on, until we have a sufficient number of replications, with duplication or triplication in different parts of the Union—in other words, a series of experiments that will enable us to separate the relevant from the irrelevant. I do claim that we have not yet done that, and it is up to us to do it. It will take 20 or 30 years, but it is worth doing. We must do it, just as the same work is being done in America, and with a sufficiently critical basis. Then again there must be habitat development studies for various regions in relation to different exotics, under different systems of management; this requires careful study. We must first of all investigate the area, chemically, physically and biologically. We must then treat it silviculturally—plant it and control it—and we will then in course of time be able to collect data with reference to development and the changes that occur in the soil, because the soil is as dynamic as the vegetation. Then again, succession changes require careful study in connection with the reafforestation of areas, more especially where scrub and forest growth has been before. I think that here a great saving in run-off and undue use of water by trees can be brought about, if we bring our plants in at the correct stage in the succession. There is a very important point that I should mention in conclusion. Before planting certain areas that may be important locally or in relation to the question of water supply, let us wait until we have sufficient data to satisfy ourselves that we are correct. It has been said this morning that problems are much the same in general principle in different parts of the world. But I should like to put the opposite view, that we are finding more and more that the problem on one side of the hill slope is not necessarily the problem on the other side.

Mr. R. W. Thornton (Basutoland, Bechuanaland and Swaziland): I am attending this Conference as an Agriculturist, not as a Forestry Officer, but there are one or two points which I should like to mention from the agricultural side of this great question we are dealing with. Unfortunately every country that is inhabited can hardly be maintained in the condition in which it was found prior to its invasion by man—man who should be the protector but who is often the destroyer.

In our agricultural practice as compared with the forestry practice, I would like to mention the cultivation and production of maize. Maize is a crop which is produced over a very large area of country, and from investigations made, we find that where it is grown and where similar crops are grown, the loss that takes place in regard to surface soil, and the colossal loss of water that occurs could hardly be equalled in connection with any type of forestry practice. I mention this as it has a bearing on the whole question of soil and water conservation. I would now like to deal with this subject from a slightly different point of view to that dealt with so far. In one of Kipling's famous Indian stories, he mentions a village surrounded by forest—where the forest was dominant—the people were removed, and the jungle took possession. This case is comparable with what I saw in the Southern Sahara a good many years ago, where a once flourishing oasis had existed. The palms had been cut down and the

desert had rolled in and taken possession. I therefore feel that whatever the opinion may be with regard to our rainfall decreasing, the desert is rolling in and taking a great portion of this country from us, due to the destruction of tree growth. The position is one which necessitates very careful investigation. We know of three (what may be called) low climax periods or rainfall periods in the years 1802-13, 1862-63, and 1932-33. In these periods it looked as though the desert had taken possession. The dust drove over from the west and covered the Free State and in many parts there was a layer half an inch thick. Trees would have prevented this wind erosion as they do erosion by water. Trees are the best agents for slowing down water flow, and the slowing down of wind velocity near the surface of the earth. If we can slow down our water flow we naturally check erosion, and if we can slow down the wind velocity near the surface of the earth, we not only check erosion but we reduce evaporation. I do not desire to go into detail in connection with any dispute that may arise between the advocates of afforestation and its opponents, or the question whether afforestation may or may not be desirable in certain sections of the country. But I wish to stress the fact that burning on a gigantic scale takes place throughout the grass veld and savannah areas of this continent. There is no control of the burning which has denuded the country of vegetation, thereby breaking down not only the ordinary grass, but destroying and curtailing the whole of our tree growth. The destruction of the tree growth must at least have this very vital effect, that the principal slowing down agent to the movement of wind over the surface of the earth is removed, and therefore we must have wind erosion and high evaporation from the earth's surface. This is not only a South African question: it is an international African question, and indeed affects the whole continent. Africa is in a pecular position in that the continent is inhabited by some 143 million native people—who have not reached a very high state of civilisation—and some three million Europeans dotted about the country from the Cape Coast to the Mediterranean. With this uncontrolled burning that takes place not only in the native areas but also in some European areas we are definitely concerned, it destroys the natural vegetation and particularly the forest vegetation, or the natural bush which is the principal agent in the slowing down of the flow from our heavy storm rainfall and the velocity of the wind. In 1906 we carried out certain evaporation tests, one set near the coast, in a section of the country where the rainfall was only ten inches, but where humidity was highest, the second in an area of a 25-inch rainfall up country, where the humidity was very low, and we found that the actual evaporation was greater in the 25-inch rainfall area than in the 10-inch area. Forests and forest growth may not perceptibly affect the rainfall of a country, but they must, I think, have some effect on the humidity of the atmosphere, and they certainly assist against the terrible drying out process that takes place due to the high winds. Finally, I would urge that this Conference, before it breaks up, should strongly recommend that investigations covering this whole question should be carried out, not only in this country, but wherever a simalar set of conditions exists; I think that a very wide range of experiments and investigations should be carried out over a long term of years. Speaking as an agriculturalist, I would not like to see that during the period occupied by these investigations any slowing

down should take place in the work of preserving the natural herbage of this country, and particularly its tree growth, and no slowing down with regard to replacing that growth where it has been removed due to the destructive agencies mentioned.

Dr. Reynecke (Union of South Africa): I must say that this is a great surprise to me and not a very pleasant one in that I have not prepared myself to speak on this matter. I have been much interested and impressed in the question brought up by Mr. Keet, and which was so thoroughly gone into by Dr. Phillips. I think that possibly Mr. Keet has in mind the mass effect of afforestation, and not so much the local effect that it may have on a particular area or a particular spot. I hope the foresters will discuss this matter in a broad sense. Speaking as a man who has grown up in this country I have been very proud of one of our first Governor's actions, or decrees and that was that any man who chopped off a tree should plant two in its place. Now speaking as one who has only recently entered into a new Department of State—the Native Affairs Department—I must say I agree with the previous speaker as regards my superficial observation, and that is that while the trees may or may not by transpiration take more water from the soil they certainly have an enormously beneficial effect in reduction of the high evaporation such as we have in this country. The effect is shown directly by the results on vegetation, which grows under the natural scrub timber that we have in South Africa. The bushveld region which is largely occupied by our native peoples and only very incidentally by the white farmer, is subject to enormous destruction to-day through the felling of native timber. In those cases we find desert conditions approaching more rapidly than where the native timber has been maintained. We have some of our best grasses growing under these trees. In fact from the agricultural and pastoral point of view we find that our best species grow under these trees. The trees themselves are no doubt deeper rooted than the exotics which we have introduced on a large scale, and which have a surface root system. The others have a deep root system. But whether we take the exotics or the other kinds, there is no doubt that the accumulation of moisture, or rather the humus which holds the moisture in the surface soil, is greater under the trees than in the open veld, and we find in the case of exotics anyway that we have some of our best grasses growing there. Viewed from the purely pastoral or agricultural point of view, I must say that my own observations lead me to this conclusion, that afforestation in areas that have been deforested is essential. In native areas especially it is imperative that we not only conserve the natural timber but that we replace the timber where it has been removed. In order to check the enormous surface evaporation, and to check the surface erosion which is caused by water and wind, this policy is essential. I was struck recently on some of my visits to the sand veld in the eastern Transvaal at the enormous deterioration which has been caused through the chopping and felling of timber by natives. In the sand country is was observed that where these native trees have been felled the ground begins to move, first of all through man stirring it, and after that the winds blow and move the sand and throw it up on the land in the form of dunes. So that from that point of view especially—that is from the point of view of erosion by wind as well as water, I do feel that not only should the conservation of our natural timber receive

careful attention, but where necessary we should replace this natural timber either by native timber or exotic timber. It is a question which should receive very serious attention. I would like to say that I am all the more concerned about the re-establishment of our native timber. I realise that the process is a very lengthy one, and no doubt Mr. Keet and his co-workers feel that the process is too slow, and is of doubtful value. But it seems to me that a different aspect has been brought out by Dr. Phillips in regard to the habit and growth and rooting system of most of the exotics in this country as compared with our own indigenous trees. The question of allowing native timber to re-establish itself is also a very difficult one, and it seems to me that in many cases in certain areas that I have to do with the process is going to be rather slow, if we leave it to nature alone. My question, therefore, is, cannot we do something to help nature in re-establishing these forests by actual planting, and in other ways inducing the native timber to become re-established.

Mr. Roberts (Union of South Africa): As Dr. Reynecke has mentioned, this debate has come at rather short notice, and therefore I am not very well prepared. But I speak as an engineer, who is interested in anti-soil erosion work. I have really only one point that I wish to bring out, and that is this, that from my own observation forestry as generally practised consists of trees planted fairly close together in regular formation, and apart from the pines that make a fairly extensive litter underneath, the gums and similar trees cause the ground beneath them to become totally bare and dried out to a very great extent. Now, one of the earliest speakers this morning mentioned that in Nigeria I think it was, in the high rainfall area of 360 inches, peculiarly enough the erosion was less due to water than in the other area where the rainfall was only ten inches. Well now, that is exactly our own experience, and I put it down to this fact, that if soil is kept continuously moist to a certain degree, the root systems of the smaller plants never entirely die out, and when storms come, the soil is bound together by this tiny but all-pervading root system. Our trouble here is where you get a semi-arid area, and where everything grows well including grass and small shrubs until you get a drought, and then these small roots die, after which you are at the mercy of the first storm that simply rips out the whole area. That is the trouble. So that I feel very strongly, partly from the point of view of anti-erosion work that our indigenous bush in South Africa has enormous advantages. In the first place, speaking subject to correction, I believe that our indigenous trees do not draw on the water in the soil as heavily as some of the exotic species. Secondly, the growth is such that they do not stand alone. As trees, they are accompanied by all forms of shrubs, grass and other vegetation, which blend together and form more or less a complete protective mat, and therefore I wish to suggest that every possible attention be given to the possibility of bringing back our indigenous bush with its accompanying vegetation wherever possible.

The Chairman: I should like to know whether we have with us to-day any gentleman who will not be accompanying the Conference in its further stages, and who would like to speak on this occasion.

Mr. Carlson (Union of South Africa): I must apologise first of all, because I am in a rather bad condition of health just at the moment, and I find it very difficult to speak at all, owing to the fact

that I am suffering from an abscess on my tongue. There is only one point that has been brought forward that made me rise, and that is in regard to the remarks made by Dr. Phillips. He made a very strong point in regard to the difference in the conservation of moisture in the natural forest soil as against the soil in which exotics are planted. I would just suggest this, that he has perhaps overlooked one fact in making such a big distinction between exotics on the one hand and indigenous trees on the other hand. Now the point that comes to my mind is this, that the indigenous forests as we know, are composed of a large variety of species with different kinds of foliage, which when it decays makes very excellent mixture of humus, and one which retains the water like a sponge. Certainly we notice that the same thing does not happen at all events to the same extent in pure pine or pure gum forests. I have thought over this matter a good deal during my half century's experience in this country, and I have always felt that what we want is to find a means of mixing our species to as great an extent as possible, not only from the point of view of the conservation of moisture, but also from the point of view of producing better qualities of timber. You all know that there are many species of trees in the world, which produce much better timber, by mixing different species than they do when they are grown pure, and therefore I feel sure that it is not beyond our ability to find suitable species for mixing in many situations in this country.

The Chairman: I am sure you will all wish me to thank Mr. Carlson for his remarks. He is one of the oldest technical officers in the Union. (Hear, hear.)

Mr. Hunt Holley (Union of South Africa: In my remarks to you to-day, speaking as a layman, I shall endeavour to approach this subject from as practical a point of view as I possibly can. Comparisons between exotics and our indigenous forests have been made. I am satisfied in my own mind that if it were possible to speed up the growth of our indigenous trees and plant them in pure stands in a similar manner to that by which we have treated our exotics, we would get precisely the same results. Now I do not know if it would be possible to do this, but it would certainly be a very interesting way of approaching the subject. References were also made to wattles—probably the greatest criminal ever introduced into South Africa in the opinion of some, if the matter is looked at from one particular point of view. Gentlemen, I am exceedingly sorry that when I had the honour of demonstrating to you what could be done with the wattle, ample opportunity of studying this particular tree was not given to me. There were many examples that I could have shown you very much better than the examples that I was able to bring to your notice. But unfortunately, time did not permit of this. The bareness of the conditions under our trees grown by new methods was also mentioned by Dr. Phillips, but gentlemen, whether the soil is bare or whether it is not I undertake to say that no member of this Conference was able to find any trace of run-off. Now, Mr. Chairman, surely those of us who are growing exotics in this country have just as much right to the use of the water as anybody else. At least I content that we have as much right to the use of the moisture of this country, provided we use it as it should be used. At any rate we have as much right to the use of the moisture as for example the people in the city of Pretoria. I understand that this

city of Pretoria uses approximately 11 million gallons of water a day. That of course definitely means that the people below Pretoria have so much less water. But surely that water is being very well used. I have made use of a very extreme case, probably, but I wish to emphasise the point I am making that we both have the same right to the use of the moisture in the soil,provided we make a right use of it.

Professor Sutton (University of the Witwatersrand): The request has been made that some of us who have special knowledge of South African conditions but who are probably not directly associated with Forestry, should say a few words on this subject. Now in saying what I am about to say, I want to approach the matter from the point of view of a Civil Engineer who has specialised in Irrigation. That is to say to a certain extent I start really at the end of the story, namely, as an engineer who takes the water as it arrives in the street, and he is naturally concerned both with its quantity and quality. I think there is no engineer who would disagree in the slightest in regard to the point that everything possible should be done to bind the soil together, as Mr. Roberts has explained. So that we have the water running into our rivers and flowing along and not carrying large portions of the countryside with it, thereby silting up our reservoirs and channels. So that we now come to the other side of the question, namely that of quantity and mode of distribution. Let us take the position and examine it from the point of view of the engineer. As regards South Africa, we find that the only satisfactory position known to-day is to make an analysis of what total water has fallen on the catchment area, as the results of the records obtained from rain gauges, and what water has passed over some particular gauging point. The position in South Africa is a most distressing one in spite of all the grandiose talk about our huge water resources which do not actually exist. If we average the position, probably we shall find that some streams do not give more than half to three quarters of the run-off, as we put it in percentage form. Probably if you take the whole country only about six per cent. of our rainfall finally appears in the rivers. That is to say, we have to face this fact, that when rain falls on the surface of the earth, it is disposed of in three different ways. Some of it runs immediately off the surface of the soil; some goes into the soil; and the balance we can only assume is lost by evaporation. Therefore, we must take it some 94 per cent. of the water that falls on the land never reoccurs. That is to say, it does not appear in any direct process. Now the engineer, naturally working between the two extremes of the initial rainfall and the final result of the run-off of water, as it is found in streams, is interested in all the intermediate stages to which this water must be subjected, and he comes to the conclusion that it is affected by the physical topography of the country, the geological formation, and the porosity of the rocks as well as the natural surface cover. And it is at this stage that the interests of the irrigation engineer and the forester are almost identical. The problem it seems to me is nevertheless one for the forester, and not directly for the engineer, and we simply have to face this fact. One speaker, Mr. Keet I think it was, referred to the sort of super idealistic notion of what we may term the 100 per cent. run-off catchment area. I admit that if you make it very steep, and absolutely impermeable, then a catchment of absolutely 100 per cent. would be recorded. In fact, that has been done on a small scale, in places like Gibraltar and Southern Australia but it is

essentially a very small problem of a very small water supply, and the engineer has no interest really in that form of collecting water. When it comes to large scale operations, particularly in a country like South Africa where you have extremes of dry winter, and heavy summer rainfall, the serious problem which confronts the engineer is to decide what he is going to do with this water assuming he can get it. You may collect the water in the reservoir, or by means of dams in the rivers, but in any case that water is subject to extremely high evaporation, and therefore to a large extent, after conserving it he has to lose it once more, so he comes to the conclusion that the forester is the chief person who can help him with this problem. Of course we know that there are some trees which break up the soil and provide some opportunity for water finding access to underground strata, and we pay a small penalty in the case of transpiration which goes on in connection with these trees. (Hear, hear). Now, naturally it is not for the engineer to discuss whether one type of tree or another would best suit the conditions of South Africa, but it seems logical that if trees are to be planted simply in order to increase the water resources, they should be those which break up the underground subsoil to the greatest extent, and which at the same time use up water to the smallest extent. The forester, therefore, makes one of the biggest contributions to the water supply of the country to the extent to which he slows down the natural run-off, and reduces these other conditions which cause the loss of moisture. To that extent his services are of the greatest economic value. So we find that the forester is really engaged in creating an underground reservoir throughout the country which feed the streams not only directly but all the wells and windmills which rely upon it.

In conclusion, Mr. Chairman, I should like to make this remark, that we have very little true information in this country regarding the relations between rainfall and run-off under specific conditions. We know for example that on an average any half inch rainfall in South Africa is of no use because it goes off straight away in evaporation, and if we are dealing with the question of run-off and rainfall relations we consider that if we are to do the job properly, we must eliminate all rainfalls or less than about half an inch as being of no effective value whatever. Therefore, it follows that the effective rainfall in most places in South Africa is extremely small. I think myself that the only way in which we can get any true data on this subject is for us to gauge small catchments, and for the Forestry Department and the Hydrographic Survey Department to combine together in order to get hold of catchments or the same catchment which can be sub-divided, assuming it is a river. You must have the same rainfall conditions and topography applying to one portion or tributary, and you must plant one type of tree, say the exotic species in that portion, and you must plant the other with indigenous trees; then after a certain period of time you will have comparable data. I would like to see full co-operation established in this work between the Forestry Department and those who are interested in the water supply directly, which I think must be to the benefit of the country as a whole.

Mr. T. M. Mackenzie (Union of South Africa): Speaking as a wattle grower, I think Mr. Hunt Holley has covered the ground. I think that under the newer methods we have adopted, we are now conserving as much moisture as we can on our farms. Our experience

is now that whereas formerly there was a good deal of run-off after a storm, there is now very little. In fact one may say there is no run-off on our farms at all. Our springs are stronger during the winter than they were previously, and we feel convinced that we are at least retaining the water on our farms instead of allowing it to run to waste as was formerly the case, and furthermore our present methods enable us to retain the earth which was formerly washed away by these heavy downpours. I might mention that I was quite a young boy when my people first came to South Africa, and they built the house under the hill because there was a stream close by, and I remember in my young days there was a duck pond in front of the house. Well, that stream though there being no afforestation at all absolutely dried up. That was due to not planting trees, but whether there was burning as well, I do not know. What I do know is that by the time I was 21 we had to find our water elsewhere. Things are very much better to-day in that respect. And I want to add this, that that was before we planted any of these horrible wattles that we sometimes hear so much about. Before the trees were planted, the stream dried up. We tried windmills, and eventually I piped water from a considerable distance to my house, which I have built on the hill. As I say, conditions are much improved. I mention this case because we hear from time to time the cry that South Africa is drying up—or that portion anyhow. As far as burning is concerned, I am looking forward to the day when the only fire that will be allowed on my estate will be the one that cooks the meals. We will have no burning at all—no bush fires or anything else of that kind. I agree that the devastation of the veld in the spring when our first rains come must be largely due to that cause, and through that we lose most of the water. So I look forward to the time when there will be no fires at all, neither grass nor bush fires. With regard to forest areas, I think some legislation might be brought forward in that respect,that in such areas no fires should be allowed at all. I think that would be a great help in preventing the huge fires which occasionally devastate these forest areas and that in my opinion occur mostly from carelessness.

Mr. G. A. Wilmot (Union of South Africa): I did not intend to contribute anything to this debate, but I consider it my duty to say something, because I have practised afforestation and am still practising it. In fact I have been engaged in this work for 33 years. At the present time I am on the research committee for the wattle growers. I have listened with considerable attention to the remarks which have been made, and in particular to what Dr. Phillips has said, and were it not for the fact that I know that the Forest Officers of this country are most thoroughly conversant with the points he brought forward I would urge them to give very close consideration to them. But as I say I know they are doing so. I know they are fully alive to these points, and that they will continue to give them their attention. From the remarks of Dr. Phillips one would almost conclude that he wishes us to practically abandon the planting of exotic trees in this country, but I do not think he can quite mean that. He also appears to be alarmed that the Forest Department might make the error of planting such trees and in such a manner as to cause the evil effects which he fears. But I do not think there is the slightest danger of their doing this. Now just to say a word or two about these exotics. I know to some extent the

danger of planting them and causing a diminution of the water supply. But I think our Forestry Officers know better than that, and where there are places where there is a danger of a diminished water supply as a result of the planting of exotic trees, they will refrain from planting. But to sound a note of warning that we are to abandon planting exotic trees sounds almost absurd, if I may be allowed to say so. I would like to give one example. A man living at Kwambonambi in Zululand, on the flats, where practically no erosion can possibly occur, planted 2,000 acres of *Eucalyptus saligna*. At that place there is subsoil moisture, almost independent of rainfall, and I personally purchased that plantation from him 18 months ago, and I paid him £45,000. Well, that represents a considerable amount of revenue to this country, and I may say that the Company for whom I purchased the trees will also make a considerable sum of money, besides which it will aid considerably the industries of the country. In regard to wattles, which at first sight without looking carefully into the position, might be regarded as trees which would cause a diminution in the water supply, what I can state is this. As I said at the beginning of my remarks, I am on the research committee of the wattle growers, and I can give it as my evidence that on the estates which are now being managed on the system recently introduced by the Forestry Department of this country there is no run-off between the trees. I am sorry in my evidence to have to contradict Dr. Phillips, but I am speaking of what I have seen with my own eyes. I can state that as soon as they abandoned burning, and placed brushwood in rows apart, there has been no flow-off. That the trees use water is a physiological matter. That is a function of plants which we, of course, all know about. All plants use water, and we require it ourselves in order to produce what the country requires. From wattles this country derives about two millions a year which is a considerable sum. In fact, the wattle industry is rapidly becoming the fourth largest industry in South Africa. Therefore, we cannot conceive that the scientist can actually mean that we should abandon the planting of these trees as well as gums in suitable situations and under proper management.. As I said before, we know, of course, that the trees use water. That is the payment we make for the two millions we obtain. But they do not allow that water to run away to the sea where it would be useless, as happens to such a large percentage of the rainfall of this country. The trees make use of it, and give us a yield and a product which is of great value. Of course I know full well the value of the natural vegetation on the surface of the soil, and on my own estate I make it a rule never to allow a man to plough or cultivate the ground in the ravines. I leave areas between my fields for natural growth. And what I know myself is known even much more so to the Forest Officers of this country, and I am sure they will bear these things in mind. Therefore, in conclusion, there is no necessity for me to urge upon them more than they are doing at present to take a careful note of such ideas as have been so ably put forward by previous speakers. I will bring my remarks to a close by saying that I listened with particular interest to the very able manner in which the Chief Conservator of Forests put the case before the Conference, and I am able to say after 33 years of work in this country that I completely endorse all he said.

Mr. C. E. Lane-Poole (Australia): There is only one point that I want to take up. Professor Phillips told the Conference that leaf litter

of wattles and gums, so I understood, would remain on the ground for a considerable time, and then disappear largely in geseous form. Now had that statement come from a layman it might have been passed over as due to faulty observation. But in the circumstances I wish immediately to refute that statement. The effect of this statement was that eucalyptus and wattles rob the soil of their plant foods, and the litter disappears in gaseous form into the atmosphere. Well, does Professor Phillips wish us to believe that they are volatalised? Actually, what does occur in the eucalyptus forests of Australia, is that the leaf litter disappears by slow cooking and disappears very rapidly. But it all goes back to the soil. We are not acquainted fully with what happens to the nitrogen, and work is still going on on that part of the subject, but the theory is that myriads of the soil fauna help to consume it, and the soil flora fixes it. Anyhow, that is the position in regard to Australia where the *Eucalyptus* is the main forest species, and grows to a height of 300 feet. Were that statement of Professor Phillips' correct, and were these trees robbing the soil of their food constituents, and were the undergrowth robbing the soil of its plant foods, there would be no forest left in Australia. No further proof is necessary, I think, to show that that statement is incorrect.

Dr. Unwin (Cyprus): Forest destruction began in Cyprus about 3,000 B.C., and went on until 1878. There was an enormous amount of erosion, aggravated by the numerous numbers of goats. Since Professor Troup's visit to the island in 1929, in many private properties there are now four terraces, compared with only one previously, and in recent years the Forest Department has spent £1,600 in making terraces and stopping erosion over an area of about 1,000 acres. In 1926 the Secretary of State sent out a special circular to the Governor of Cyprus asking for a report about the destruction of the hill forests, and measures for stopping erosion. The place names of the country are useful indications to show where the forests have been destroyed or where better conditions prevailed in past years, as witnessed, by the place Salamis, meaning "Sweet water", where now there exists only saline water.

(*The Conference Adjourned at* 1 *p.m.*)

(*Debate continued on* 17*th September.*)

Mr. P. C. Kotzé (South Africa): Looking at the matter from a South African's point of view, for the purposes of this discussion it seems to me rather unnecessary to go into the matter of the various beneficial influences that forests may exert. I think it is right and proper that we should confine ourselves to two main aspects, that is erosion in the first place, and the drying up of streams in the other. In most other countries, generally speaking, this sort of controversy will not exist, for the simple reason that nature has provided forests over a very large percentage of the area. In South Africa it is the other way round. It is very probable that if we in this country disturb the balance of nature, something must be upset. Now there is the alarmist who fears that if the balance of nature is upset in that way, the ultimate effect will be disastrous. It is not doubted by the

forester that if South Africa for example could be left entirely undisturbed—that is to say to the free play of natural forces—then our indigenous vegetation, whether grasses or whatever else, will form a sort of sponge, preventing run-off, and at any rate will not be upsetting the balance of nature as we find it here. On the other hand, it is impossible from the point of view of progress to leave these vast areas to themselves. We must derive some benefit from them. No doubt there are indirect benefits, but unfortunately it will take centuries I am afraid before the very small minority will be able to make their arguments felt in regard to the vast possibilities. Direct beneficial use I am afraid is the only practicable way of utilising these areas. I am now referring to the catchment areas of our country. It has been the history of South Africa that if such areas are thrown open to agriculture or grazing, the results are disastrous. The evil of grazing plus the evil of burning is certainly very disastrous. Those who fear that plantations exert a bad influence will agree, I think, that it is far better to have plantations than to have grazing plus veld burning, or agriculture on very steep mountain sides. So that from the forester's point of view and as we see it to-day, we feel that in the direct utilisation of these catchment areas forests have been more beneficial than agricultural pursuits. That of course is from the point of view of deriving direct advantages from the utilisation of the soil.

Now it is argued sometimes, though it is not a very strong argument I am afraid, that in regard to areas under forests or plantations,—and I take it we are now confining ourselves to these because that is after all our chief term of reference—that plantations may, as I have seen myself, cause erosion. But it is not the plantations themselves that are the cause of erosion. It is in much the same way as areas of grass land that will not cause erosion if animals are kept off, that a properly managed plantation will not encourage erosion. South Africa is full of examples of mismanaged small wood lots, chiefly in the hands of the private owner, who may establish a wood lot for the purpose of sheltering his stock. In course of time, stock will take shelter, and on the high veld and other parts of the country where these small wood lots are established, the result is, treading down the soil and destruction of the humus. So that in that particular instance it is not the plantation that is the cause of erosion, but the animals grazing there. The other day in the Kruger National Park, many of us I suppose were alarmed at what might happen there when game increased in numbers. Destruction of the vegetation due to over-stocking with game was visible in various parts of the area that we traversed. It looked as if we were asking for trouble in that respect. As the animals increase there, the vegetation is trodden down, heavy rain follows, and this no doubt causes an immense amount of sheet erosion, and the destruction of seedlings and trees. So that even if an area is left entirely to nature, in which case the biological factor comes into play, dangers are ahead. Take an indigenous forest, if it is mismanaged, it may cause erosion, and most of us have seen that, particularly on steep hill sides, so it is all a matter of management. A well managed plantation or forest is no doubt the best means of keeping our soil intact.

Then there is stream flow which is causing some serious alarm. I myself have no knowledge of any streams that have actually dried up as a result of plantations of exotics, I only know this from hearsay.

But if that is the case, I can assure the Conference that there will ot be very many cases that can be cited. But a vast number of other ases can be cited, both from my own personal knowledge, and other- ise—in fact everybody in this country will know of them—where reams have dried up as a result of mismanagement in the ordinary ourse of agriculture. We have many cases of that sort where streams ave definitely dried up as the result of bad management. If there anything in this theory of drying up streams by plantations, it may ave an entirely temporary effect. If it occurs it is probably because ur plantations are established by means of pioneer plants, that is to ay, light demanding plants. In their earlier stages, they are no oubt exacting on these conditions, but speaking from my own xperience as a forester, it appears to me that in regard to these so- alled exacting plantations which will not even allow their own young take shelter, under the wing of mother trees, after a certain period, robably towards the middle rotation, they become less and less xacting, I could quote many examples of that. For instance we ave that voracious blue gum. We find that most of the forest floor bare, and nothing will exist during the younger stages but after- ards ferns and indigenous trees make their appearance, showing that this particular stage in the existence of the plantation the trees are ot so exacting as when they started. Examples could be quoted *d lib.* and it seems to me that in course of time there will be many ore examples to quote. It might in fact become the rule, and if this so, and it is contended that streams dry up through the planting plantation trees, these streams may become perennial again. I ink one must be very careful and observe . One thing is clear, we ust not become hysterical about these things. I myself have no oubt that a properly managed plantation (and I am referring to lantations continually) will do no harm. In regard to indigenous orests, we are all agreed, I think, that they would not perpetrate e evil deeds that our plantations are supposed to be guilty of. I aintain that the case against plantations soaking up moisture and reventing streams from flowing, has not been proved. I certainly not think that plantations of exotics will cause erosion if properly anaged.

It has been said that the time has come for a compromise between e forester and a nature lover. I do not know what this means. It ay mean that the forester will have to compromise to himself. If any rate, such compromise be called for, I think the facts of the se are that ours is not a tree country. We will have a very small ercentage of our area under trees at any time even if we increase ir forest resources to the maximum. I should say that at least vo thirds of our forest reserves will never be planted with trees hether of exotic or indigenous species, because they are inaccessible d unsuitable, and there will be vast areas left for those who love to e the South African countryside clothed with its own indigenous ora.

Further in connection with this matter. I think it was General muts who referred to compromise. I am sorry I have not got the cture with me, but I remember a little while ago in one of the lustrated papers, the General was shown on the slopes of Table ountain on a hot day, sitting down on a bed of pine needles under e shade of *Pinus pinaster*. In the picture one could see what ppeared to be a patch of wag-'n-bietjie and protea bush, but the

General did not take advantage of the seat of the wag-'n-bietjie, nor of the shade of the fynbos, but sat under the pine trees. What better compromise could have been reached.

Mr. J. B. Clements (Nyasaland): It may be of interest for me to mention that in Nyasaland, an important factor in the cause of desiccation and erosion is the physical change which takes place in certain soils after they are put under cultivation, and this particularly applies to lateritic red loams and ferruginous soils, which are very extensively distributed in the Protectorate. They soon become crusted, resulting in a very much reduced power of absorption, and an increased run-off of rain water during the short rainy season. Erosion is mainly sheet erosion, although the scouring out of stream beds has become serious in a few localities. Gullying is not widespread, and is usually confined to a few localities where there is over-grazing, and in others where the soil is abused in primitive methods of growing finger millet. Ample evidence is available as to the drying up of streams follownig the destruction of forests, and other vegetation involved in native agriculture, which is to be discussed to-morrow. The reverse process has also been recorded. I may say I saw a reverse case of a stream flow coming back after a long resting period. There was a mission abandoned over 40 years ago at a place called Hora in the Zimba district of Nyasaland which is very dry. The natives cleared the ground by what we call the axe-and-fire method, that is, burning the soil to a very intense temperature, in order to get a thick crop, and presumably to get partial sterilisation. There is ample evidence, both European and native, that a fairly big area in that region was cleared entirely of vegetation. Hardly any vegetation at all was left. Grass disappeared, trees disappeared, and the local water supply dried up. They moved the mission about 150 miles away, but after 40 years rest, the natives have started coming back, to the old spot. Open woodland has grown up again, and there is ground covered with acres of herbaceous growth. It was the late Dr. Laws who was 54 years a missionary in Nyasaland, and who followed David Livingstone, who pointed it out to me. He had been there, as I say, 54 years, and had seen these changes. That can be verified, and I saw myself the newly established villages and the revived water supply. In the formation of plantations, particular care has to be taken in the cultivation of those soils liable to crusting, which I have mentioned, otherwise increased erosion and run-off may be set up. In the case of even-aged stands, plant litter and humus usually prevent sheet erosion, and soil crusting, but at present it is impossible to say whether as much moisture is absorbed by the soil under such conditions, as compared with those in which a low plant cover plays a part. One other point in that connection might be mentioned. About 25 years ago, at the Livingstonia mission in the northern district, they installed a hydro-electric plant for the mission station, and they were very perturbed about not getting a very good water supply, but following a scheme of afforestation, Dr. Laws assured me that they had got an increased stream flow, and the requisite power for the plant, and I believe it has been maintained ever since. They put down very large areas of eucalypts for the whole of the catchment locality. I can only give you the evidence, that the stream flow was definitely increased after the plantations had had about six or seven years of life, and I have not heard of any further trouble in connection with that power scheme since that time.

Mr. Nils B. Eckbo (South Africa): A great many speakers have spoken on the great benefits derived by mankind from forests, and the inevitable disaster following forest denudation. As far as I could gather from Dr. Phillips' address, he was in agreement with those views, when applied to the countries concerned, as well as to those parts of this country covered by indigenous vegetation. I stand open to correction if I am wrong, but I think Professor Phillips condemned the introduction of exotic trees for two reasons, namely, they use more water, and in some cases they cause erosion. But I would point out that no data was submitted in support of these contentions by Professor Phillips, and he furthermore stated in his address that no one for or against has enough evidence at present. In spite of this inadequacy, he urged the curtailment of afforestation for possibly 20 years until these points could be proved. In regard to water consumption by exotics it is inconceivable to my mind that this could possibly be of such proportions as to outweigh the great advantages of a national wood supply which are too numerous to mention.

The plantations inspected at Coetzeestroom, Berlin, Tweefontein and Graskop, had exceptionally good soil cover in the shape of organic matter precluding any tendency to erosion, and judging from other plantations as well, I can only conclude that those instances known to Professor Phillips must be of such rare occurrence as to be negligible. There would seem, therefore, no good reason to retard in any way the almost phenominal success of one of South Africa's best crops at present, but I would heartily support all necessary research, as well as all possible expansion of the indigenous forests, because of their botanical interest and tremendous sentimental value.

Mr. E. A. Garland (India): In opening this debate Mr. Trevor referred to the remarkable destruction that had taken place in India and other countries by the denudation of forests. My sole excuse for occupying the Conference is that I should like to augment what he said with a few facts, referring to a case in India where it was found definitely possible to check erosion and to improve soil conditions by good treatment. Before giving those facts, I want to emphasise that point of good treatment. A negative policy of no treatment is definitely found to be useless. Certainly in the presidency which I come from, that is Bombay, and I think possibly elsewhere, forestry conservancy in its early years was rather too inclined to a negative policy. That is to say, they said that simply stopping grazing would be sufficient, that the tree growth would come in again, and we should be able to clothe our bare hillsides with what we wanted. Unfortunately, although that might have been the case in the course of years, the process was excessively slow. Denudation and the general destruction of vegetation had gone so far that the process of reconstruction was extremely delayed, indeed almost invisible. Whether land is best utilised as forest or pastures is a matter of ecological status and economic conditions and the basis of such utilisation must be a detailed survey and careful land classification.

Now to turn to this particular instance, of which I wanted to give a few data. At Poona, which is the summer capital of the Bombay presidency, we had an area of about 40 acres, which the Forest Department had fenced and closed to grazing. The area remained closed I believe for about 40 years, and the result was

almost negligible. The climatic conditions were that there were about 24 inches of rainfall, and the area was situated on the tension belt between the thorn scrub and mixed deciduous forest. The vegetation consisted chiefly of thorn species with a few very scrubby mixed deciduous species, and a great deal of the very inferior grasses, the *Aristidas*, *Andropogon contortus* and so forth. There was a definite amount of erosion which was steadily increasing. This erosion was creeping up the small nullahs, or the dongas as you would call them in this country. It was gradually creeping up the hillside. Then, in conjunction with the Agricultural Department, we started an experiment of controlled grazing in this area. The Agricultural Department also built small stone walls, very low indeed, along the contours in places where there was any sign of erosion and divided the area into paddocks. First of all, in the first year, they put ten cows into this particular area. After about three months the poor things were so hungry that they jumped out and ran away. They then divided the area up into four paddocks, three of which were grazed in rotation, and one kept for cutting grass and making hay. When I say in rotation, there was no fixed rotation at all. The animals were simply moved from paddock to paddock, as the grass was used up. They were grazed as closely as possible in each paddock, and then moved on to the next. Well, the result of that treatment in five years was that they were maintaining on that particular area 20 cows throughout the whole year in very fair health indeed. But the point which is of particular interest was that the vegetation had been definitely improved. The *Aristidas* and the other inferior grasses had almost entirely disappeared, and very much better grasses such as *Anthisteria ailiata* and *Andropogon pertusus* had taken their place over the entire area. But it did not stop there. The forestry object was also being achieved. The state of vegetation and succession had been so much improved that in spite of this very heavy grazing the natural regeneration of our mixed deciduous species and particularly the *Terminalias* began to make its appearance. Moreover erosion had been checked. So that in five years we had reached the stage in which the soil had been so much improved that it would be possible to decide on the economic point of view, whether we desired to carry on with our natural vegetation and turn it into a small fuel supply area, or whether it was desirable to assist the milk supply of the city. For a small scale experiment I think the Conference will agree that it is interesting, and the details have been published, in a bulletin by the Bombay Agricultural Department.

Prof. John Phillips (South Africa): I fear that in my talk the other day, I must have failed to make myself perfectly plain, judging by the impression that has been picked up by Mr. Wilmot, which has also been referred to by Mr. P. C. Kotze and Mr. Eckbo. I think in my statement to the Committee on the Forest Influence, I did make this point clear, and I think I also made it clear the other day at Berlin Plantation. The point at issue is this, I did not suggest that afforestation with exotics in South Africa should definitely be held up. Anyone who made such a claim would be speaking quite irrationally. One realises perfectly well that trees have to be grown for economic purposes. What I did attempt to plead was that we should exercise care as to where these exotics are established—that is the water demanding exotics, such as the eucalypts, the wattle and much lower down the scale, some of the pines. I want to empha-

sise this point, because it makes all the difference between an apparently very extreme view—almost hysterical view—and the point of view that it is well worth while to look into this matter of probable soil deterioration and excessive water consumption. We heard on Wednesday afternoon of several examples. I remember some were mentioned by Prof. Troup regarding the suspected influences upon soils of pure stands of conifers, I believe in Saxony. And other examples could be cited. I have put forward these views and suggestions in the hope that they will arouse foresters to look very seriously into the matter. I am sorry, if through my inability the other day to make these things clear, I should have caused any misunderstanding in the minds of those persons who listened to me. Unfortunately, this caused Mr. Eckbo to believe perhaps that I had made a very definite attack on afforestation in general, but I have not done that. I have simply asked for an investigation and have suggested in the meantime, that areas of paramount importance, whether large or small, and whether owned by the State or private individuals, should not be planted with fast-growing water-demanding exotics if water supply in that area is of the first importance.

Mr. H. M. Gardner (Kenya): In all these discussions on forest influence we are all very seriously lacking in authentic records, and it seems to me that we have in South Africa a very good chance of obtaining really accurate data of the effect of forests on water supply. I remember when in New Zealand, I made a suggestion to the New Zealand Forestry Department at Rotora, that in view of the very extensive planting work being done in a treeless area there was a great chance to start a series of rain gauges to see if this vast area of new plantations had any effect on local rainfall. They admitted there was a good opportunity, but apparently they had so much rain in New Zealand that it was of no practical interest to them. But in South Africa, I think there is an excellent opportunity in connection with such catchment areas as the Sabie and Weza Plantations, where there are a number of small streams, of obtaining invaluable records of the effect of tree planting on run-offs. I suggest that a definite and comprehensive scheme of stream gauging should be adopted in all afforestation areas, by the Irrigation Department and Forest Department in collaboration. Then we should have records, not only of great value to South Africa but to the world as a whole.

Mr. Trevor (India): In the course of this debate you have listened to the experiences of members of this Conference in various parts of the world, and you have been given instances from history of the results of the destruction of forests on the civilisation of man, and the fertility of the land. Mr. Galbraith dealt with the importance of the Murray River catchment area, which is the source of a very important irrigation scheme on which the prosperity of three states in Australia will depend. Mr. Keet dealt with the desiccation of the country—from the standpoint of South Africa—which is so apparent to many people who have lived in this country for many years. He stated that rivers which at one time had hippo-pools in them no longer possessed these pools. Mr. Ainslie dealt with the very serious wind and water erosion in Nigeria—its effect on the savannah forest there, and the degradation of soil which has resulted from the various destructive habits of the people such as fire, grazing

and cutting, so that countries which were at one time prosperous and carried a large population, and a certain amount of civilisation, have deteriorated, and the land had practically become a desert. Mr. Finlayson dealt with the sand dunes formation along the banks of the St. Lawrence River, which I have seen myself. In the early days farms were cut out of the forest, and these were succeeded by the formation of sand dunes, and now mankind has to rebuild the former conditions at considerable expense. He also dealt with the decrease in stream flow of the St. Lawrence River—one of the chief waterways of the world. He also drew attention to the fact that afforestation on the Elbow River had had a beneficial effect. At one time there was very little water there and now, when trees have come up again, the stream flow has been revived. Professor Phillips has warned us as to the effects of planting certain water-demanding trees in a country like South Africa, but from what he has just told us I do not think he has much disagreement with most of the members of this Conference. He simply states that we should be careful where water supply is of paramount importance as to what type of vegetation we use—for the conservation of that water. I think therefore that I am correct in quoting Prof. Phillips that the main point of his argument is this: he does not dispute the fact that forests have an excellent influence on erosion of the soil. He merely wishes to point out and emphasise that especially in the case of the eucalypts and possibly acacias, and to a less extent in the case of pines, we should not do anything in this direction until we have full knowledge of the subject.

In my opening remarks I stated that erosion was due to the mismanagement of the soil—whether it be by destruction of the forest by fire, by excessive grazing, or whatever it might be—I think that we are all agreed that the fundamental causes of erosion, which are so serious throughout the world, are the mismanagement by man of the resources placed at his disposal by a bountiful nature.

In dealing with the management of the land, it is no good saying that if land is left alone it will do all that is necessary. That no doubt is quite true, but man does not live by scenery alone. Man must exist: he must produce crops for his sustenance, and timber to build houses and for other purposes. Therefore what we are concerned with is a reasonable management of the land, whether it be forest land or wattle land, agricultural or grazing land. If you can only have reasonable and proper management of the land surface the problem of erosion would be solved. But unfortunately we who may recognise these evils and their remedies have to deal with a large body of opinion, often ignorant, which is not prepared to accept what we may say, or even if they are prepared to accept it they are not prepared to be restrained in any way from the destructive practices to which they have been accustomed. One of the best things that we, in co-operation with the agricultural officers can do is to try and preach the gospel of a reasonable and efficient management of the land. I think one of the most important arguments which have been put forward as supporting our contention for the benefit of forests was the remark of Mr. Thornton that trees diminish the force of winds and thus mitigate sheet erosion and slow down the water flow of a given area, and in irrigation matters that is of supreme importance. Great floods of water come down from the hills but they are of no use. The water does not penetrate

into the soil and cannot be utilised in large volume. It silts up the dams, ruins the irrigation works, destroys the railways and does untold damage. If forests can merely slow up these floods that alone is of inestimable value to mankind. If you were to consider the cost to the engineering departments of the railways of the world and other bodies on account of repairs that have to be made due to floods, all the money spent on forestry throughout the world would be a mere drop in the ocean. We have had this statement made to us by Mr. Roberts of the Irrigation Department. He has told us that he entirely supports Mr. Ainslie's statement that erosion was worse in areas of low rainfall, where the roots die and the surface of the soil is blown away, and that he preferred natural forest in such areas where water supply was of paramount importance, and I think that we as foresters would not do our profession any harm if we subscribed to that statement until such time at any rate as the contrary has been proved.

Mr. Hunt Holly also gave us his opinion, founded on great experience that the proper management of the wattle industry had had no bad effect on the soil: that erosion on his land, which we ourselves have seen, was non-existent, and that the planting of that large area of wattles had had no ill effect on the water supply on his farm. He moreover pointed out that on his neighbour's land which was largely unplanted very serious effects from floods had been experienced over a series of years. Mr. MacKenzie told us that he had more water than before.

I do not think it necessary to go into all the statements which have been made here: they all more or less bear out the general statement that afforestation has a remedial influence on stream flow, and on erosion, and if that is so we are doing a great deal of good in the world in trying to get as large areas as possible of suitable land growing trees instead of rubbish. (Hear, hear.)

I think therefore I may sum up the whole trend of the debate by saying that we attach great importance to a thorough investigation of these many problems which have been placed before us. We have an opportunity now in co-operation with eminent men—agriculturists, engineers, botanists—and others, in regard to this matter about which a certain amount of controversy has arisen, but when all things have been boiled down really very little controversy in fact exists—we are all agreed that a really thorough series of investigations should be carried out in co-operation with all interests concerned, and extending over a series of years on this important question. (Hear, hear.)

The Chairman: That will close this discussion on Forest Influences, and it will not be heard again in plenary session, until the committee stage.

(Conference adjourned at 6 p.m.)

ANNEXURE IV.

SOIL EROSION.

The problem of soil erosion in this country is too vast to allow of general treatment in a short discussion; I shall, therefore, confine myself to only one aspect of the problem, and that with a view to seeing whether the assembled experience of Forest Officers from all over the world cannot help us in a very difficult problem that confronts irrigation engineers, namely, the silting up of storage dams.

Our greatest trouble exists in a strip of country approximately along Latitude 32°, stretching for about 400 miles and about 100 miles wide below the Great Karroo escarpment. It is probably generally known that a very large proportion of the area of South Africa consists geologically of the Karoo formation, which was laid down in an inland sea over a very long period, and reached the enormous thickness of as much as 4 miles. This was gradually elevated and the highest point now reaches over 11,000 feet above sea-level.

From the seaward side erosion has been going on for countless ages and the escarpment has gradually retreated from the coast inland until it now forms the long continuous escarpment from the Drakensberg through the Zuurberg, Sneeuwberg, Nieuweveld and Roggeveld escarpments.

In a sense perhaps we ought to be thankful for this erosion, because it has produced some low-lying country with great richness of soil, but where the rainfall is low and erratic, and storage works are required to enable us to irrigate the rich alluvial soils, the erosion is an unmitigated nuisance. The percentage of solid matter in the waters averages from two to as much as four per cent. in a number of streams that come down from this part of the escarpment.

We have built a few storage works in this area and would like to build many more, but until we can reduce the percentage of silt in the waters, we see a very short life ahead for the storage works.

Now, the rainfall over the escarpment in the area with which we are chiefly concerned varies from 10 inches to 20 inches. It is extremely erratic and it is of the thunderstorm type, the bulk of the rainfall being chiefly in the three late summer months of January, February and March. The vegetation is chiefly the Karroo bush. The slopes are in private occupation and are fairly heavily grazed by sheep.

We feel that if forests could only be grown in that area with some hope of profit, erosion would be very much retarded, and there might be a better outlook for storage works across the intermittent streams that come down from the escarpment, but we fear that afforestation is not likely to be an economical proposition, or even possible in these areas; however, we would be exceedingly indebted to any forester who could throw out any practical suggestions that would help us in solving this great difficulty. I do not mean the growing of small clusters of trees along a narrow fringe of the river. That involves small scale operations which we encourage.

In other areas where we have, or contemplate, large storage works, silt is not such a serious menace, but it exists all the same. We know, however, that there afforestation is possible and we encourage it in every possible way, but in the area that I have specified the problem appears to be almost insoluble. We would like to know definitely whether we can look to afforestation for any assistance. If we know definitely that there is no hope in that direction, we must concentrate our efforts in other directions.

(Sgd.) A. D. LEWIS,
Director of Irrigation.

ANNEXURE V.

THE EFFECT OF AFFORESTATION ON WATER CONSERVATION WITH SPECIAL REFERENCE TO SOUTH AFRICA.

Our general problem in regard to rainfall is to see that it does as little harm and as much good as possible, and to-day we are concerned with the particular part that afforestation plays in this problem. I do not propose to enter into the complicated discussion as to the effect of afforestation on the water balance of a country. That is a matter on which officers experienced in forestry can speak with much greater authority than an irrigation engineer. I am inclined to think that the weight of evidence is in favour of the view that the more densely an area is covered with tree-like vegetation, the less will be the *water* run-off from that area, but that any adverse results are often balanced by a lessening of *soil* run-off or erosion. My remarks will be based on that view.

Taking the run-off first, one has to valuate what the effect will be of the diminution. The uses to which water is put in this country are—

(1) navigation,
(2) water power,
(3) industrial and municipal uses,
(4) watering of stock,
(5) irrigation,

In regard to river navigation, this problem does not arise in South Africa.

In regard to water power, this is exceedingly limited.

In regard to industrial and municipal uses, the total requirements are insignificant when compared with our total water resources, and in almost every case storage works are essential. We are left, therefore, with water supply for stock and irrigation as the two uses which might be adversely affected by any increase in the afforested area.

Let us first consider the areas in South Africa which have a rainfall exceeding 40 inches. The total of such areas in South Africa is less than 22,000 square miles, or less than 5 per cent. of the whole area. It is shown on the Rainfall Map of South Africa within the area coloured red.

From this 22,000 square miles we must first of all deduct the areas which are not suitable for afforestation, through lack of soil, inaccesibility, unsuitable climatic conditions, or for any similar reason.

Then we can also eliminate those areas where, even if afforestation were to cause a considerable diminution of flow, there would still be enough water for all purposes. Under this heading we should class all those areas where, even when the maximum demand for stock purposes and irrigation is satisfied, there will still be water running uselessly to the ocean or across our borders throughout the year. Such areas would be along the strong streams flowing from the high mountains above George and Knysna, and most of the long

narrow coastal strip along the East coast from the Portuguese border down to East London (about 7,000 square miles), a considerable part of which lies either in Native Reserves or is taken up with sugar cultivation. There are also parts of the Zoutpansberg slopes feeding the strong Pafuri River, which runs through a Native Reserve, skirts the Game Reserve and passes into Portuguese country; the irrigation possibilities are very small along the river and afforestation in the upper reaches can have no serious effect. The Olifants River and the Sabie River, both strong rivers east of the Drakensberg, also run through the Game Reserve into Portuguese East Africa, and the irrigation possibilities can never absorb the whole low-flow of these rivers, in both cases over 100 cusecs. Where such conditions are established, it would be folly to oppose afforestation solely on the grounds of diminution of run-off.

Then we should also eliminate much of the area above constructed or projected large reservoirs for storing flood waters, where the diminution of flow due to afforestation can have very little effect on the controllable water supplies, and, on the other hand, forests might cause a considerable improvement in reducing the amount of silt that would settle in the reservoirs. Such areas are the upper reaches of the Olifants River in the Cape, serving a very large storage dam, portions of the high country affecting the Brandvlei Dam, and portions of the catchment of the Zonder End River, where there are possibilities for large conservation works.

If all these deductions are made, we will be left with a red area which could safely be placed at less than 1 per cent. of the whole area of the Union, or, say, less than 5,000 square miles, where diminution of river flow would require more serious consideration.

Where the natural flow is sufficient for stock purposes, the problem is largely an economic one, weighing up the advantage of forests as against irrigation.

In a very large proportion of the debatable area, storage works are not economically possible on account of the steep slopes; and the amount of irrigation that is possible from the *direct* flow is very limited, on account of the very low flow in the critical months round about September. In these areas irrigation alone, therefore, will be able to stop only a very small proportion of the total run-off of water from reaching the sea.

For the above reason, most of our State expenditure on irrigation works has been outside the debatable area. We have spent some 10 million pounds on irrigation works, and I can say with certainty that afforestation has not appreciably diminished the value of any of the works; on the other hand, erosion and silting have proved very serious devaluators. I do not know what the direct financial outlook is for State Afforestation works, but, if it is anything like that of irrigation, the argument as to our respective merits might be likened to one between two unsuccessful merchants discussing which can pay more than, say, 5s. in the pound.

If the Forestry Department can show that their forestry operations produce better economical results than irrigation in the relatively small areas where they conflict, they would certainly have a strong case in favour of afforestation. They certainly have this in their favour that they are producing an article which is *imported* into this country, whereas a large proportion of the produce derived

from irrigation requires to be *exported,* assisted as a rule by heavy subsidies.

Summing the matter up, I am certainly of opinion that there is no justification for a *sweeping* condemnation of afforestation policy on the score of diminution of river flow, and that the areas that deserve the most careful consideration in any proposed afforestation schemes are those occupied by farmers along small tributary streams within close proximity to the area that is to be afforested in steep country where storage works are very costly.

(Sgd.) A. D. LEWIS,
Director of Irrigation.

PLATE 1.

Plates 1 and 2.—Natural regeneration of indigenous high forest species in plantations of exotic trees.

PLATE 2.

PLATE 3.

Mat of needles in young pine plantation protecting the soil from erosion.

PLATE 4.

Brush piling stacked along the contour after clearfelling of a wattle plantation. The rows of brush are left to decay and to accumulate silt.